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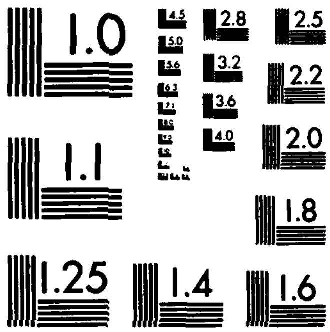

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PROCESSING THE ARMY'S WARTIME REPLACEMENTS: THE PREFERRED CONUS REPLACEMENT CENTER CONCEPT

THESIS

Darell L. Nepil
Captain, USA

AFIT/GOR/ENS/87D-12

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Instructor Operations Research

Joseph R. Litko, Major, USAF
Instructor Operations Research

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Abstract

This research effort developed two models to assist in the analysis of the role of the CONUS Replacement Center (CRC) in the Army's Wartime Replacement System. The first model, the macro model, was a network flow model which was used to analyze the flow of replacements from their source through the CRC to the theater of operation. The second model, the micro model, was a simulation model which assisted in the analysis of the internal operations of the individual CRCs.

Through the analysis of the macro model, recommendations were made on how the CRC system should be configured in terms of size, location and number so as to satisfy the replacement demands of the theaters. The simulation model served as a tool to understand the functional and resource requirements the CRC places on its operators and its host installation. After a review of the practical implications that effect an Army system during war, a preferred CRC concept was recommended.

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PROCESSING THE ARMY'S WARTIME REPLACEMENTS:
THE PREFERRED CONUS REPLACEMENT CENTER CONCEPT

THESIS

Presented to the Faculty of the School of Engineering

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Operations Research

Darell L. Nepil, B.S.

Captain, USA

December 1987

Preface

The purpose of this research was to develop a CONUS Replacement Center (CRC) concept that best served the wartime replacement demands of the United States Army. In support of the research effort, the United States Army Soldier Support Center has provided the data which formed the basis for personnel replacement supply and demand, and CRC capabilities. Two models were constructed with this data. The first can be used to determine the number, location and size of the CRCs given a specific wartime scenario. The second model, given this same scenario, can be used to determine the specific resources required of individual CRCs and their associated host installations.

I am extremely indebted to my faculty advisors, Major Daniel W. Reyen, USA, and Major Joseph R. Litko, USAF, for their assistance and guidance throughout the course of this research effort. Their comments, concern and supportive counseling in the preparation of this thesis are greatly appreciated.

Grateful acknowledgement is made to the members of the Analysis Division of the Soldier Support Center Combat Development Directorate for providing the stimulus to this thesis and all the required background data.

Finally, a very special thank you goes to my wife Mary for her understanding, patience and support throughout this entire research effort.

Darell L. Nepil

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Abstract

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Keywords: Army personnel replacement, Casualties, Personnel management, Army facilities, Network analysis (Management), (Theses)

PROCESSING THE ARMY'S WARTIME REPLACEMENTS: THE PREFERRED CONUS REPLACEMENT CENTER CONCEPT

I. Introduction

> First, war in the future is likely to be characterized by a level of violence and destruction that far exceeds anything witnessed before. Second, we will be operating in an environment that will stretch our war-fighting and sustainment capabilities to the limit and beyond. Finally, it may well be an integrated battlefield, with conventional, nuclear and chemical munitions employed in a variety of combinations and intensities [19:12].

This is an excellent depiction of the intensity and lethality soldiers in the United States Army will experience in future conflicts on the AirLand Battlefield.

To meet the immediate and massive personnel demands of that battle, it is essential that the Army establish a personnel replacement system that is capable of being responsive, efficient and effective in this type of environment. Clearly, "A smoothly working adequate replacement system is of the highest importance to the successful prosecution of war" (2:4)

The doctrine of the Army's current wartime personnel replacement system calls for the establishment, upon mobilization, of CONUS Replacement Centers (CRCs). As the name implies, the CRC is a stateside center which processes replacements prior to their shipment overseas to the theater of operation. This type of replacement flow is shown in Figure 1.

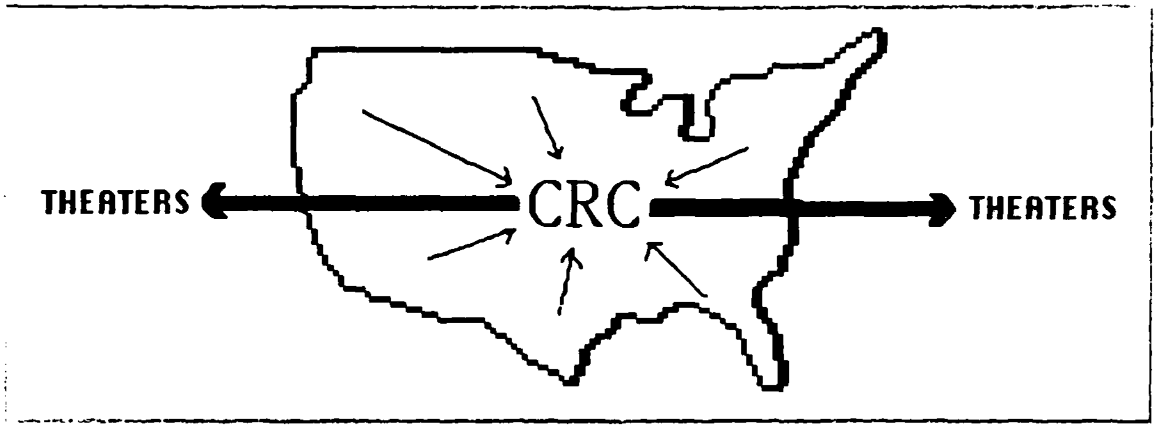


Figure 1. Personnel Replacement Flow

Over the years, numerous variations on the name, number and location of CRCs, the manning and structure of the CRCs, and the responsibilities of and tasks to be performed by the CRCs have been prescribed (2,4,7,10,13,14,17,25). On 24 July 1987, the Army's Vice Chief of Staff approved still another version (3). This latest concept involves the immediate establishment and operation of eight CRCs by Army Reserve Personnel and Administration Battalions. Their mission is to verify that replacement units and individuals are indeed prepared for overseas deployment.

Specific Problem

The Vietnam era was the last time the Army exercised its wartime replacement system. Since then, major modifications have been made to the system without further testing, exercising or modeling. Thus, there currently does not exist a methodology for accurately determining the structure (number, location, size and function) this network of CRCs should entail so that the Army's personnel replacement demands can be met during the next war.

Literature Review

For this thesis, the literature review focused on the following three primary areas:

1) a brief history of the predecessors of the CRC;

2) the current CRC concept;

3) the proposed future requirements of the CRC.

CRC History. Although the term CRC is relatively new, a number of sources reveal that the concept has been practiced for many years. DA Pam 20-211, The Personnel Replacement System in the United States Army (10), is extremely factual and comprehensive document which describes the evolution of a replacement system that eventually served the Army during two world wars. However, the document notes that the World War II replacement depot, a forerunner of the CRC, was not without problems:

> Most GI's remember their association with the "repple depple" as the low point in their Army life, and for good reasons. It was not at all unusual to linger in one for many months awaiting assignment. Overcrowding was the rule rather than the exception. Men were dumped together, regardless of their arm of service or their military occupation speciality and everyone took the same training.
>
> Harried cadres worked long hours trying to bring some semblance of order to these conditions. The strain made many of them irritable and the irritation was passed on to the replacement.
>
> As a result, the man moving into the theater, fresh from an outfit of which he had been an

> integral part, became a confused and hurt animal. He resented the depot; he resented the U. S. Army.
>
> But more dangerous than this resentment was the new attitude creeping into him: he was slowly beginning to feel resentment toward the country whose uniform he wore 10:436 .

Comments similar to this were not unusual; however, the real problem was, as stated in the pamphlet's conclusion, that "the Army has never entered a war prepared to operate a personnel system built upon the accumulated knowledge of past experience" (10:477).

This point of being unprepared is emphasized throughout much of the documentation. DA Pam 20-212, The History of Military Mobilization in the United States Army 1775-1945, concludes that "It can still be said that the United States has never adequately and fully planned for a mobilization before it occurred" (7:695). Similarly, an Adjutant General School Memorandum begins with the following observation:

> When General George C. Marshall was appointed Chief of Staff in 1939, he felt that the replacement plan lacked many details, and he directed that it be completely restudied. This restudy was still going on when we entered WWII in 1941; and in effect, we went to war without a firm replacement plan [26:2].

Finally, in a more current study, Strauss (25:4) states that the replacement requirements were consistently underestimated, and thus a reactionary surge in the entire replacement system resulted not only during World War I and World War II, but during the Korean and Vietnam conflicts as well.

Additionally, the various replacement policies, according to Strauss, actually did more harm than good. Up through World War II, a soldier stayed in a unit and fought until he became a casualty. This very stressful situation simply served as a multiplier of casualties. During Vietnam, a twelve-month rotation policy attempted to rectify that problem, only to add an additional burden on the overseas replacement centers (which are another forerunner of the CRC). More importantly, the continual rotation of soldiers in and out of a unit resulted in a loss of unit integrity and cohesiveness, which ultimately decreased combat effectiveness (25:91).

Current CRC Concept. With the approval of the AirLand Battle as the "umbrella concept" in the Army's Concept Based Requirements System, came the development of the Wartime Personnel Replacement Operations Concept (17). This concept differs from previous replacement concepts on two accounts. First, wartime personnel replacements consist of not only individuals, but crews, teams and units as well. Second, in order to reduce transit time, decentralize the logistic support load and personalize the replacement process, an increased number of smaller replacement centers replaced the "super-sized" replacement organization of prior wars. The motivation behind this new proposal is to improve the overall process and to allow theater commanders greater assignment flexibility (16:2; 4:H-8-6).

One aspect of the Wartime Personnel Replacement Operations Concept involves the establishment of the CRC. Upon mobilization, these centers will be the responsibility of the Commander of the Training and Doctrine Command and will serve as staging locations for individual, crew, team and unit replacements prior to their shipment overseas (17).

Once this concept was approved, the corresponding doctrinal literature was published. Both FM 12-16, Replacement Operations (13) and The CONUS Replacement Center (CRC) Implementation Plan (4) provided the details for the planning, implementation, structuring and organization of the CRCs as outlined in the Wartime Personnel Replacement Operations Concept.

First, these documents required the establishment of CRCs in three phases. Phase I would require CRCs at Forts Lewis, Jackson and Dix to be operational within seven days of mobilization. The second phase would occur 13 weeks after mobilization so as to coincide with the planned, initial training base output surge (16:9). During this phase, smaller CRCs at Forts Sill, Knox and Benning would become operational. Phase III would finally occur 30 to 35 weeks after mobilization and would involve the opening of small CRCs at each of the remaining seven Army training centers (13:2-4; 4:H-8-4).

Second, in terms of structure, the CRCs would be staffed by preselected, military retirees or civil servants. These people would be notified by the Army Reserve Personnel

Center and report in accordance with their "hip pocket" orders (13:2-4; 4:H-8-4).

Finally, the CRC's mission would be to insure personnel are prepared for overseas movement in accordance with Army Regulation 612-2, Preparation of Replacements for Overseas Movement (POR) (11). To accomplish this mission, the CRCs must perform a variety of tasks to include the following:

1) Issue required clothing, equipment and weapons.

2) Provide billeting, messing and transportation support.

3) Verify legal, medical, financial and administrative processing requirements as specified in DA Pam 600-8-10, Military Personnel Management and Administrative Procedures: Individual Assignment and Reassignment Procedures (9).

4) Perform weapon zeroing and gas mask testing.

5) Coordinate assignment instructions with the Army's Military Personnel Center (13:2-3; 4:H-8-3).

In May 1985, at a Mobilization Functional Area Assessment, it was revealed that little or no action had been taken to implement a CRC concept. Thus, the Army's Vice Chief of Staff directed the Army staff to proceed with the development of an implementation plan (21).

In response to this directive, the Proposed CONUS Replacement Center Concept of Operation was drafted (14). On 24 June 1987, the Army's Vice Chief of Staff approved a very similar version of this proposed concept. The approved version is entitled The Concept Plan, CONUS Replacement Center Concept of Operations (3) and will replace The CONUS

Replacement Center Implementation Plan and Chapter 2 of FM 12-16, Replacement Operations. Some of the changes this document dictates include the following:

1) Immediately establish upon mobilization eight CRCs at Forts Dix, Jackson, Lewis, Benning, Knox, Ord, Sill and Leonard Wood rather than use a time-phased opening of the CRCs. The location of these CRCs and their associated aerial ports of embarkation (APOE) are shown in Figure 2 and are discussed in detail in in Appendix A.

2) Structure the CRCs with a replacement battalion and replacement companies rather than with a personnel process center and replacement regulating detachments.

3) Man the CRCs at the authorized level in accordance with the newly revised Tables of Organization and Equipment 124061000 (6) and 12407L00C (12).

4) Staff the CRCs with designated US Army Reserve Personnel Replacement Battalions and Replacement Companies rather than with retirees and civil servants.

5) Rely heavily on the host installation for facilities, support and services rather than serve as a stand alone operation (3:2-4).

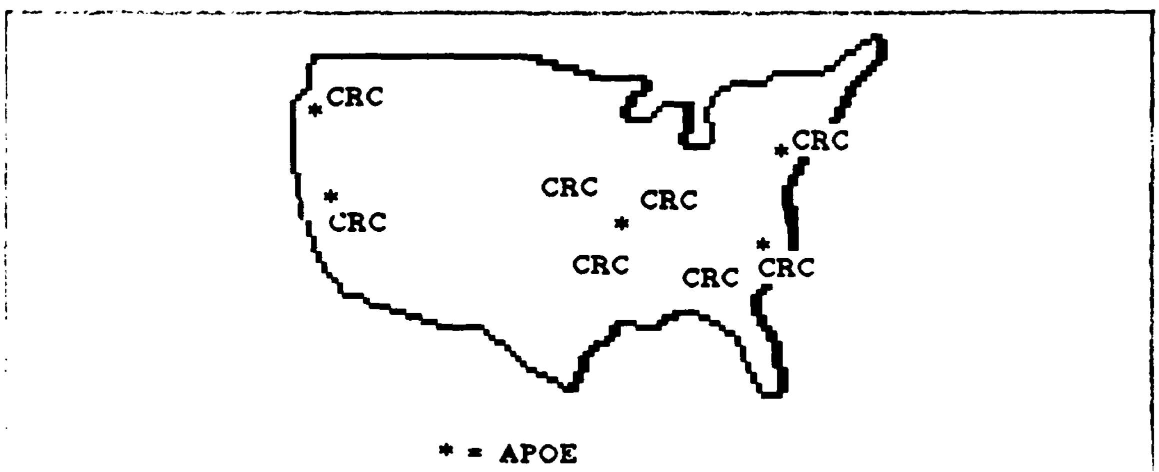


Figure 2. Configuration of the Current CRC Concept

In total, these modifications should allow for a more practical and more professional CRC structure.

Proposed CRC Future. Because the Army still has not adequately exercised, tested or modeled its new CRC concept, it is possible that the Army's present day replacement system is still unprepared for war. To make matters worse, the lessons learned from previous wars are becoming less and less relevant because of the changing pace and intensity of war. Dilworth accurately states that not only will the lethality and precision of modern weapons greatly increase the demand for replacements, but also that the fighting in the "rear" and the "deep operations" will make movement of replacements much more difficult and dangerous (19:15-18).

The reason for not exercising the replacement system, and specifically the CRC, during mobilization exercises in the past is due to the fact that the retirees and civil servants who were to man the CRC were not available (21). Fortunately, with the structure changes recently approved by the Army's Vice Chief of Staff, exercises of the CRC concept are possible. In fact, the first of these exercises took place in October 1987 during the Proud Scout 88 Mobilization Exercise. During that time, a CRC exercise at Fort Jackson was conducted by a designated Army Reserve Replacement Battalion (3:2).

An analytic model of the CRC does not exist. The closest the Army has come to any sort of analysis of the replacement concept is in the Wartime Replacement System

Study (18) and the Personnel Replacement System Policy Analysis (27). However, the members of these study groups will be the first to admit that much is yet to be done in the study of the total replacement system, let alone the details of the CRC (21).

Research Objective

The purpose of this investigation was to evaluate how well alternative CRC concepts satisfied the Army's wartime replacement requirements.

Subsidiary Questions

In order to meet the research objective, the following subsidiary questions must be addressed:

1) With regard to wartime replacements, what lessons have been learned throughout the Army's history?

2) What is the official mission of the CRC and how does this mission relate to the total replacement operation?

3) What is the demand for replacements and what percentage of that demand is placed on the CRC?

4) Who will process through the CRC?

5) What are the specific processing tasks to be completed by the CRC?

6) How much time will each of these tasks require?

Major Scope and Assumptions

To properly limit the scope of this research, the following assumptions were made:

1) The United States was under full mobilization and engaged in a global conflict.

2) Mobilization and actual conflict commenced on the same day.

3) The scenario lasted 180 days.

4) Forces in the study included the Active Army, the Army Reserve, and the Army National Guard.

II. Background

Due to the fact that this research effort built quantitative models around existing data, this chapter will discuss the specific details associated with that data. But first, in an effort to show how the data ties together, a brief introduction of the methodology is presented.

Models Overview

The data to be discussed served as input data for two models. The first model was an analytic model. Specifically, it was a multi-commodity, multi-period minimum cost network flow model that looked at the entire replacement system from source to theater. The second model was a Simulation Language for Alternative Modeling (SLAM) II simulation model which focused on the actual processing flow within the confines of the CRC. Both models operated under the same scenario and were linked together by the number of soldiers that flowed through the replacement system.

The Macro Model. The network flow model served as the "macro" model since it looked at the problem from the beginning to the end of the replacement process. The objective of the model was to minimize the total distance soldiers traveled as they moved from their source location through a CRC to the theater of operation, so as to meet the demands in the theater without exceeding the capabilities of the CRCs.

The Micro Model The simulation model served as the "micro" model since it was concerned only with the events that occurred at the CRC. The objective of the model was to give guidelines, in terms of resource, facility and time requirements, to those responsible for the operation of a CRC.

Data Collection

To correctly analyze the CRC concept, data was required in the following five areas:

1) Theater personnel replacement demands;
2) CRC processing capabilities;
3) CONUS personnel replacement sources;
4) Distances between sources, CRCs and theaters;
5) Host installation resource limitations.

Since the Soldier Support Center at Fort Benjamin Harrison, Indiana, is the Army's proponent for personnel issues, their Analysis Division in the Combat Developments Directorate served as the primary source for this data.

Theater Personnel Replacement Demands. In addition to historical data, numerous casualty estimation models were available to provide predictions on wartime casualties. For the purpose of this study, the results from the Army's Concept Analysis Agency's Wartime Manpower Planning Systems Casualty Estimation Model were used (20).

For 18 ten-day periods this model provided an estimated number of casualties for both the North Atlantic Treaty

Organization (NATO) and the Southeast Asia (SEA) theaters. The casualties were subsequently broken down into the following Military Occupation Specialty (MOS) categories:

1) Infantry personnel casualties;

2) Armor personnel casualties;

3) Field Artillery personnel casualties;

4) All other Combat Arms (Air Defense Artillery, Combat Engineers, Special Forces) personnel casualties;

5) All remaining Army personnel casualties.

It is recognized that soldiers with less severe injuries or illnesses will not be medically evacuated out of the theater, but will be treated in the theater hospitals and then be returned to duty. Thus, it is obvious that the personnel replacement demands placed on the CRCs are considerably less than the actual number of theater casualties.

To determine this adjusted personnel demand required the use of another Concept Analysis Agency model. The Patient Flow Model (20) provided, by period, "return to duty" estimates from theater and from CONUS hospitals. The theater data was broken down into the above five MOS categories for both the NATO and the SEA theater.

By simply subtracting these theater return-to-duty estimates from the corresponding theater casualty estimates yielded NATO and SEA personnel demands for the CRCs. A graphic representation of these demands are shown in Figure 3 and Figure 4 respectively.

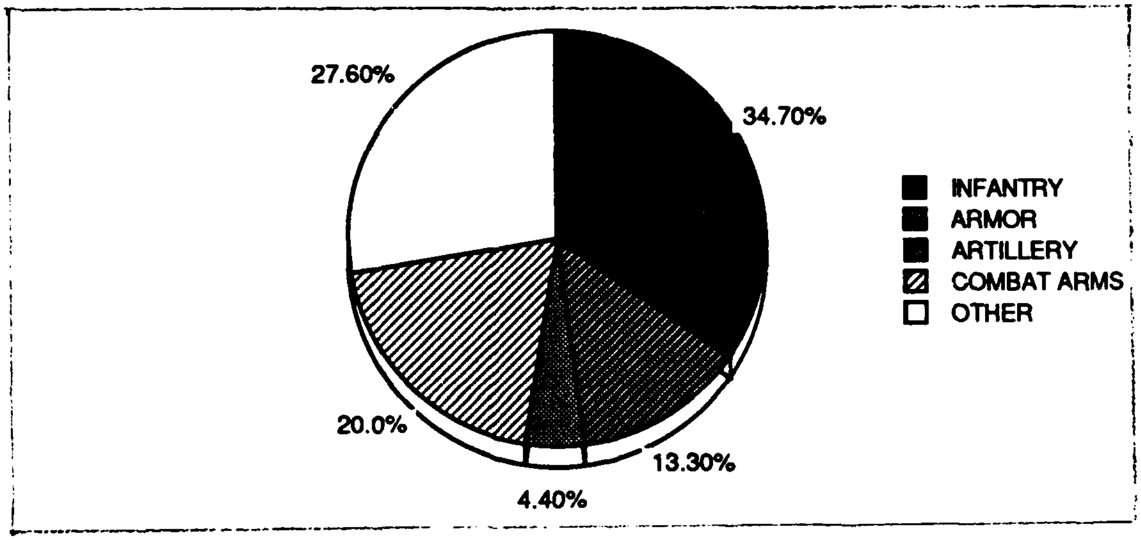


Figure 3. NATO Personnel Demands

Additionally, the personnel demands by MOS and for all six periods are listed in Appendix B for the NATO theater and in Appendix C for the SEA theater.

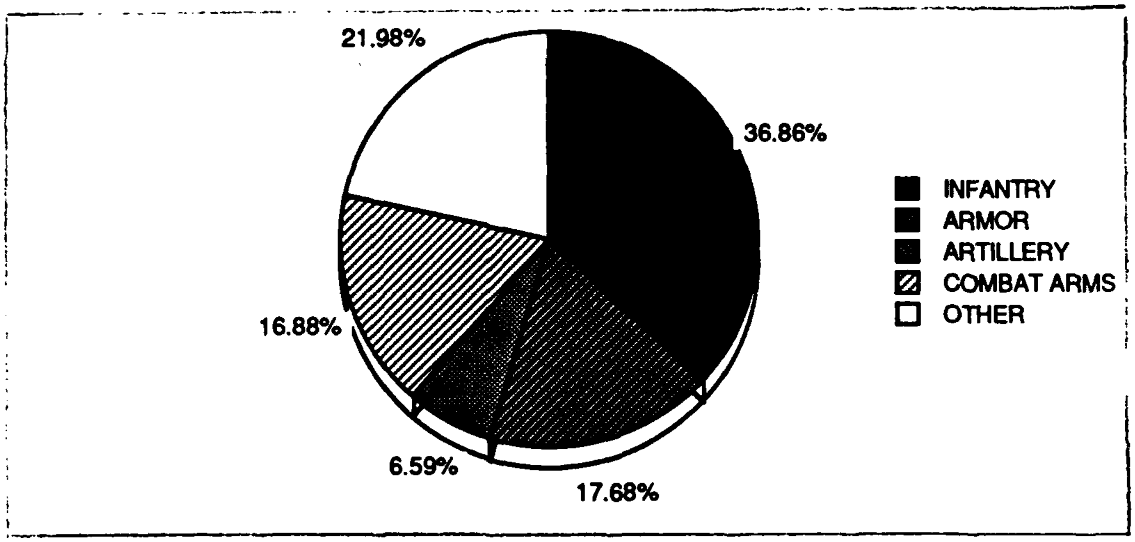


Figure 4. SWA Personnel Demands

Since MOS percentages for return-to-duty and casualty estimates for the Southwest Asia (SWA) theater were not available, it was necessary to use the NATO MOS percentages to determine the appropriate distribution for the SWA demand. These calculation are shown in Appendix D.

CRC Processing Capabilities. Although similar versions of the CRC have been operational during previous wars and although the new CRC concept was recently exercised, the exact procedures, processing times, and capabilities of the new CRC concept are still not fully known.

Appropriate approximations on the eight CRCs' capacities and capabilities was easily calculated (Appendix A) on the following basis: 1) on the average, it takes a soldier three days to process through the CRC (3:3); 2) the CRC should be able to complete the processing of approximately 400 soldiers per day per replacement company (13:2-5); and 3) each CRC will consist of three or five replacement companies (with a maximum of 400 soldiers per company) (3:A2).

CONUS Personnel Replacement Sources. Soldiers who are assigned to the United States Army Forces Command will be deployed directly from their CONUS station to the theater of operation, but all other soldiers will be processed through the CRC (16:5). The individuals who will process through the CRC will initially be categorized as "fillers" and will be assigned so as to bring the deployed units to an appropriate wartime manning level. Thereafter, these individuals will be categorized as "replacements". In either case, six CONUS "sources" will provide personnel to meet the theater demands.

Training Base. The first source of replacements, and quite possibly the primary source, is the Army's training base.

Upon mobilization, the current peacetime training base will expand over time to meet the demands of war by incorporating other active Army installations, Reserve training divisions, brigades, and schools; and, if needed, civilian industry, technical schools, and community colleges. This expanded training base will be manned by individuals from the Individual Ready Reserve (IRR), recalled military retirees, and civilians with applicable skills (16:7).

Although the Army's Mobilization Training Program includes courses for all ranks and specialties, the preponderance of the effort will go toward the training of the newly recruited soldiers. Normally, the new recruit will receive his initial entry training and his advanced individual training at the same installation and at an accelerated rate. Yet, in compliance with public law, all new personnel will receive at least 12 weeks of military training prior to their deployment (16:8,8:3-12).

The predicted number of trained recruits to graduate from the expanded training base was collected from the Army Training Requirements and Resources System data base (20). This predicted output is illustrated in Figure 5 while the

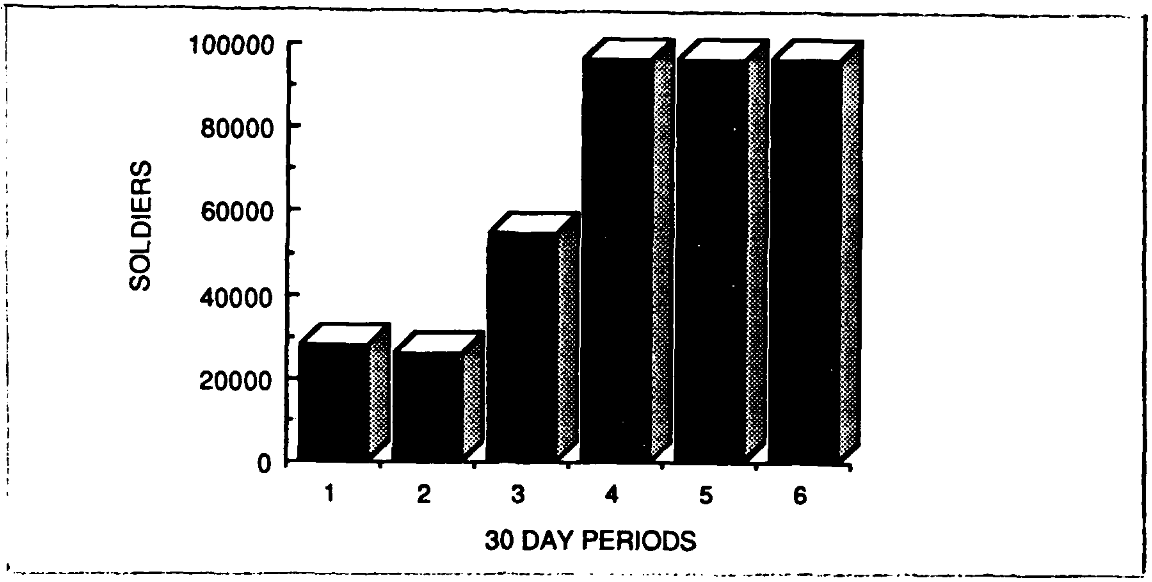


Figure 5. Training Base Output

specific number of graduates are listed by MOS and 30-day period in Appendix E.

CONUS Return-to-Duty (RTD). Deployed soldiers who have been severely injured or who are severely ill are evacuated back to CONUS medical facilities for appropriate treatment and convalescence. After the healing process is complete, these soldiers are returned to the theater for duty and thus provide the Army with a second source of replacements.

As previously discussed, the Concept Analysis Agency's Patient Flow Model provides data on theater, as well as CONUS, return-to-duty estimates. This time, it was the CONUS return-to-duty estimates that were collected for 18 ten-day periods (20).

Since a breakout by MOS on these estimates was not available, approximation measures were in order. With this in mind, the NATO MOS casualty percentages were applied against the CONUS return-to-duty estimates to yield CONUS return-to-duty estimates by MOS. A time-phased representation of available CONUS RTD personnel is shown in Figure 6. Additionally, the number of CONUS RTD personnel by MOS and period are listed in Appendix F.

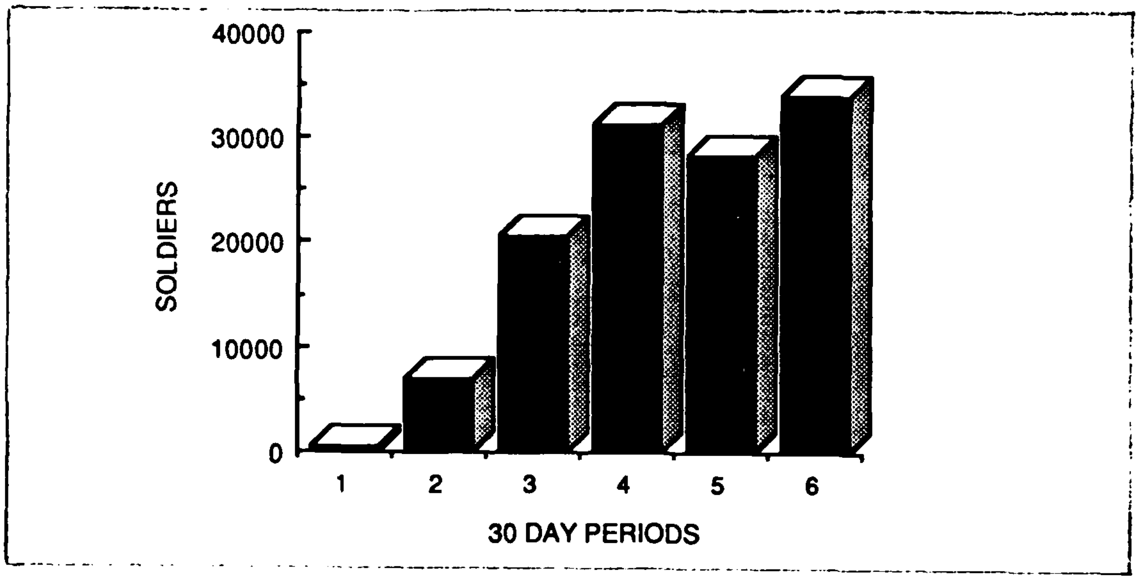


Figure 6. CONUS Return-to-Duty Personnel

Recently Trained -- 12 Months (RT-12). Upon mobilization, members of the IRR will report to designated mobilization stations. However, those soldiers of the IRR who have been assigned to an active duty or reserve troop unit within 12 months of mobilization are considered to be trained and thus deployable. It is these RT-12 soldiers who provide a third source for replacements. The Army Reserve

Personnel Center will identify these individuals and, via Western Union mailgrams, order them to report directly to one of the CRCs for processing and subsequent deployment (16:6-7). Estimates for RT-12 soldiers are based on the predicted number of IRR members who will actually report for duty. The predicted "show-rate" for these individuals is presented graphically in Figure 7 and is listed in detail

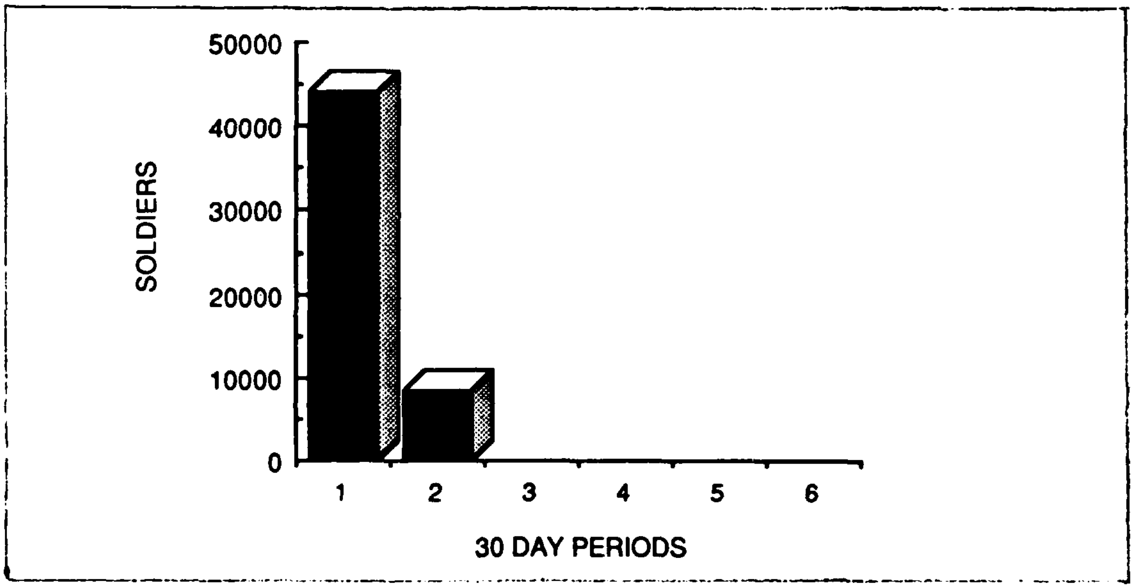


Figure 7. Available Personnel in the RT-12 Category

in Appendix G. The data for the RT-12 source was derived from the Official Guard and Reserve Manpower Strength and Statistics Report (20) and was collected for 18 ten-day periods. To appropriately distribute these figures to the various MOS categories, the current Army manning percentages of these personnel categories were applied against the RT-12 data.

Tables of Distribution and Allowances (TDA). As members of the IRR, Individual Mobilization Augmentees, military retirees and selected civilians report to their designated mobilization stations, a number of active duty soldiers will be released from their current TDA duty position for deployment overseas. With this, a fourth source for replacements becomes available.

Estimates for this category are based not only on the predicted show rate for reservists and retirees, but also on the Army's Military Personnel Center's Summary of Table of Organization and Equipment/Table of Distribution and Allowances Authorization (20). The data was calculated by MOS and time period in the same manner the RT-12 estimates were derived and is shown in Figure 8 and in Appendix H.

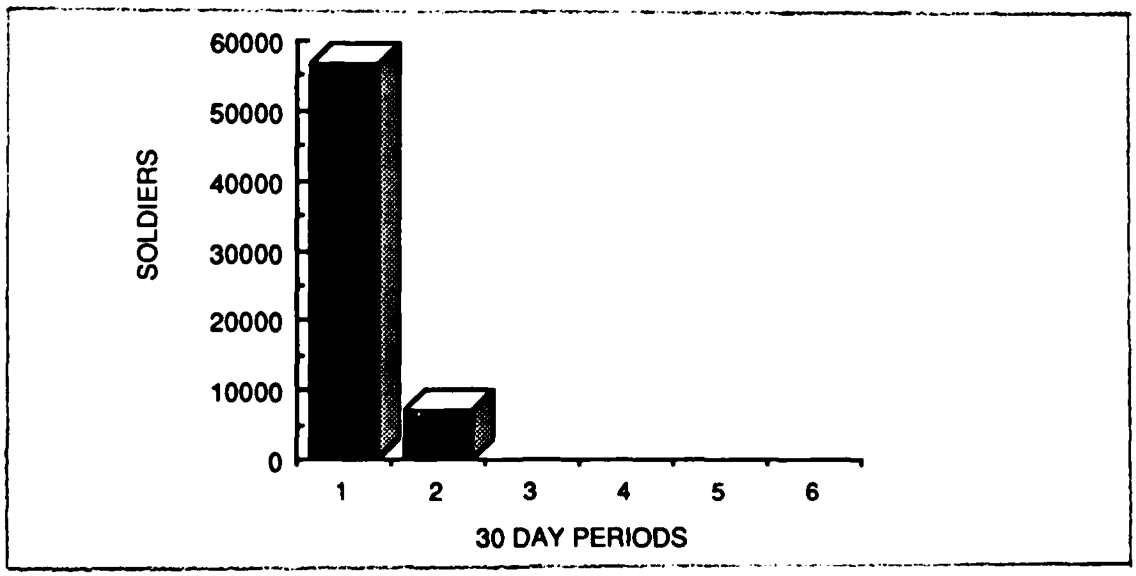


Figure 8. Available TDA Personnel per Period

Transient, Holdee, and Student (THS) Account. At any one time, a large number of the Army's soldiers are in a transient, holding or student status. These THS individuals are an obvious source for replacements because of their availability for deployment.

The data for the THS account was collected from the Army's Military Personnel Center operations data base (20). It was further assumed that all of these soldiers would be available for employment within the first ten days of mobilization and that their MOS breakout would again be determined by the current Army manning percentages. A listing of these values are found in Appendix I.

CONUS Leave. The final source of replacements is made up of those individuals who are assigned to overseas units, but who are on CONUS leave at the time of mobilization.

Although the exact figures are not available, a close approximation was attained by assuming that each soldier in the NATO theater returns for CONUS leave one time (for a 30-day period) during his three year assignment. Thus 1/36th of the assigned NATO strength gives the total number of NATO soldiers on CONUS leave at any one time.

For those soldiers with assignments in Southeast Asia, it was assumed that one out of every four takes a CONUS 30-day leave during his one year assignment. Thus 1/48th of the assigned SEA strength gives the number of SEA soldiers on CONUS leave at any one time.

Since there are very few United States soldiers stationed in SWA, the sum of the above two figures yielded a close approximation to the total for the CONUS leave category. The availability and MOS breakout was calculated in an identical manner to that of the THS account. Again, this source for replacements is exhausted after the first 30 days. Sample calculations and final results are shown in Appendix J.

Distances The location of the port of embarkation for each of the eight CRCs was directed by the new CRC concept (3:B-2) and, as stated earlier, are listed in Appendix A. The port of debarkation for the NATO, SEA and SWA scenarios was assumed to be Paris, Tokyo and Cairo respectively. The distances between these port locations, via the appropriate APOE, was calculated using commercial airline flight paths and are listed in Appendix K.

In order to calculate distances from the sources to the CRCs, a few preliminary assumptions were required. It is easy to see that soldiers who are on CONUS leave, convalescence leave or in the RT-12 category, will be located across the entire United States. Although soldiers in TDA and THS categories are admittedly concentrated around military installations, it still can be said that they will also be located across the entire United States. Thus, the first assumption was that for all sources, except for the training base, the soldiers' distribution would be relatively similar to the distribution of the United States population.

With this in mind, the population percentages of the nine geographic divisions of the United States (New England, Mid Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific) was applied to the number of soldiers in each source, by MOS and for each time period. Once the strength figures were calculated, a second assumption regarding location was required. Thus, a city in the approximate population center of each division was selected and highway distances between these cities and the eight CRCs were derived. An illustration of these nine geographic divisions and their corresponding population centers is shown in Figure 9 and corresponding population percentages are listed in detail in Appendix L. A complete listing of the distances between these centers and the eight CRC can be found in Appendix M.

For the training base, actual training locations were available through the Army's Training Requirements and Resources System. The highway distances between these locations and the eight CRCs were derived accordingly and are listed in Appendix N.

Host Installation Resource Limitations. A survey was conducted on the eight CRC locations in order to assess the

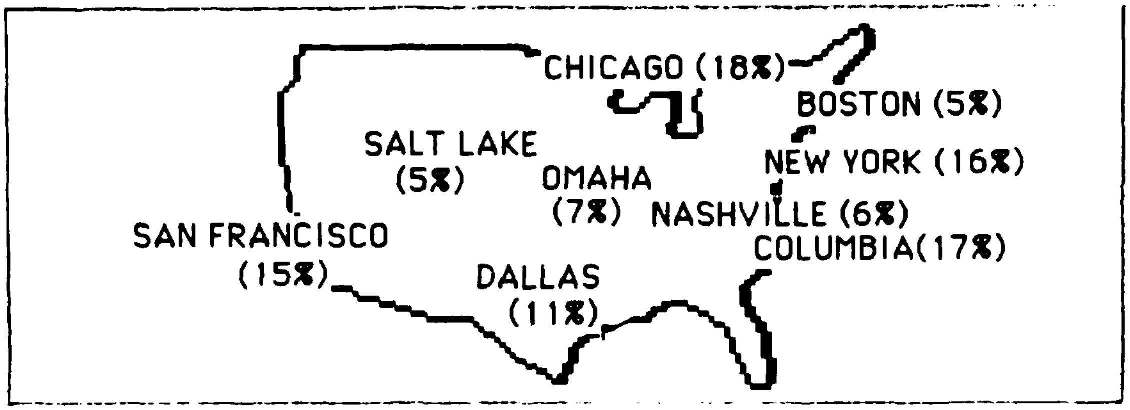


Figure 9. Population Percentages by Geographic Division in Regard to its Population Center

size of CRC an installation was capable of hosting. A count of facilities was made to determine what constraints must be considered in the models. Included in this count was the billeting, dining hall, firing range and gas chamber facilities. However, it is recognized that, if need be, the capabilities of all facilities can be rapidly expanded through temporary means. As a case in point, billeting facilities could feasibly include warehouses and tents. The results of this survey are shown in Appendix O.

A more difficult figure to assess is the number of host personnel who will be available to assist the CRC cadre through the operation of the various processing stations such as the medical, dental, dining and administrative facilities. For the purpose of this report, it was assumed that the civilian, retired and reserve population was sufficiently large to handle this requirement.

Model Assumptions

A series of assumption, in addition to those already addressed, were needed for both models so that a solution to this problem could be attained:

1) Training base output included enlisted personnel only. Officer data was relatively insignificant and not available.

2) Hawaii and Alaska were not considered in the CONUS CRC concept. Soldiers in these states were handled separately.

3) CRCs required five days after mobilization before they were prepared to operate.

4) CRCs were fully manned in accordance with the approved CRC concept.

5) All individuals, regardless of source, required the same amount of time to be processed.

The following additional assumptions were applicable to the macro model:

1) The casualty estimates from the Concept Analysis Agency's Wartime Manpower Planning Systems Casualty Estimation Model were valid.

2) The installations cited in Replacement Operations were used as the location of the model's CRCs.

3) The initial size of each of the CRCs was in accordance with Replacement Operations.

The following additional assumptions were applicable to the micro model:

1) Replacement Operations recommended a three day processing limit. This served as the model's baseline assumption.

2) CRC sizes were determined by the macro model.

3) All of the transportation, billeting, mess, and equipment requirements were met by the host installation.

4) The list of tasks to be performed by the CRC was complete.

5) Actual processing times per station matched that shown in the model's code.

6) The recycling and rejection of soldiers by the CRC were assumed to be limited and thus were not explicitly modeled.

7) Processing times were the same for all soldiers regardless of rank, gender or MOS.

Model Objectives

Given these demand figures, source data and CRC capacities, the objective of the macro model was to attain answers to the following questions:

1) How many CRCs are needed?

2) Where should these CRCs be located?

3) What should be the size of these CRCs?

Based upon the answers to these questions, the objective of the micro model was to then determine the resource requirements of each CRC so that the average processing time per soldier remained at about three days.

Model Goals

To obtain these objectives, a hierarchy of goals were necessarily built into the macro model, which in turn effected the micro model.

The primary goal, as previously stated, was to minimize the distance soldiers must travel enroute to their arrival at the theaters. However, because each CRC is run by a Reserve Personnel and Administration Battalion and hosted by the Base Operations on an installation, there is a cost associated with each CRC. Therefore, a secondary goal, to minimize the number of CRCs, was an essential element that demanded inclusion in the macro model.

III. Methodology

Having discussed the input data, it is now appropriate to determine how this data will be applied in each of the models. In this chapter, discussion will focus on the development of the models, the solving of the models and the verification and validation of the models.

Developing the Macro Model

The process of transporting an entity from place to place can easily be modeled by flow on a network consisting of nodes and arcs. Thus for this research, a network flow model represented each source, CRC and theater with a node and represented the routes between the sources and the CRCs and the CRCs and the theaters with arcs.

In the design of any replacement system, responsiveness is the primary concern. Therefore, this network's primary objective was to minimize the time it takes to move a replacement through the system to a theater. However, since the soldiers' actual modes of travel, transportation schedules and transportation delays could not accurately be estimated, travel times were difficult to predict. Yet the distances that soldiers travelled were predictable and could easily be modeled. Since, on the average, the traditional relationship between travel time and travelled distance was linear, the objective was modified to minimize distance.

In minimum cost network flow problems, each of the arcs have an associated cost. In this model, the costs equated to the distances from the sources to the CRCs and from the CRCs through the APOEs to the theaters.

Associated with each of the nodes in a minimum cost network flow problem is a fixed external flow. The source nodes had a positive fixed external flow value which was the number of replacements entering the replacement system. The theater nodes, acting as "sink" nodes, had a negative fixed external flow value which was the number of replacements arriving at a theater, and thus departing the network. Finally, each CRC node had a fixed external flow of zero because no replacements were being added to or taken out of the system at these nodes. The CRC nodes are therefore referred to as transshipment nodes.

By having replacement personnel categorised into the five military specialty categories and by having different fixed external flow values for each 30-day period, the problem became a multi-commodity, multi-period minimum cost network flow problem. An abbreviated version of this network is shown in Figure 10.

Although any linear program software could be used to solve this problem, a software program entitled NETSID was particularly applicable because of its ability to solve network problems which have associated side constraints.

NETSID is 1500 lines of code written in the Formula Translation (FORTRAN) language and incorporates a specialized technique of the primal simplex algorithm called

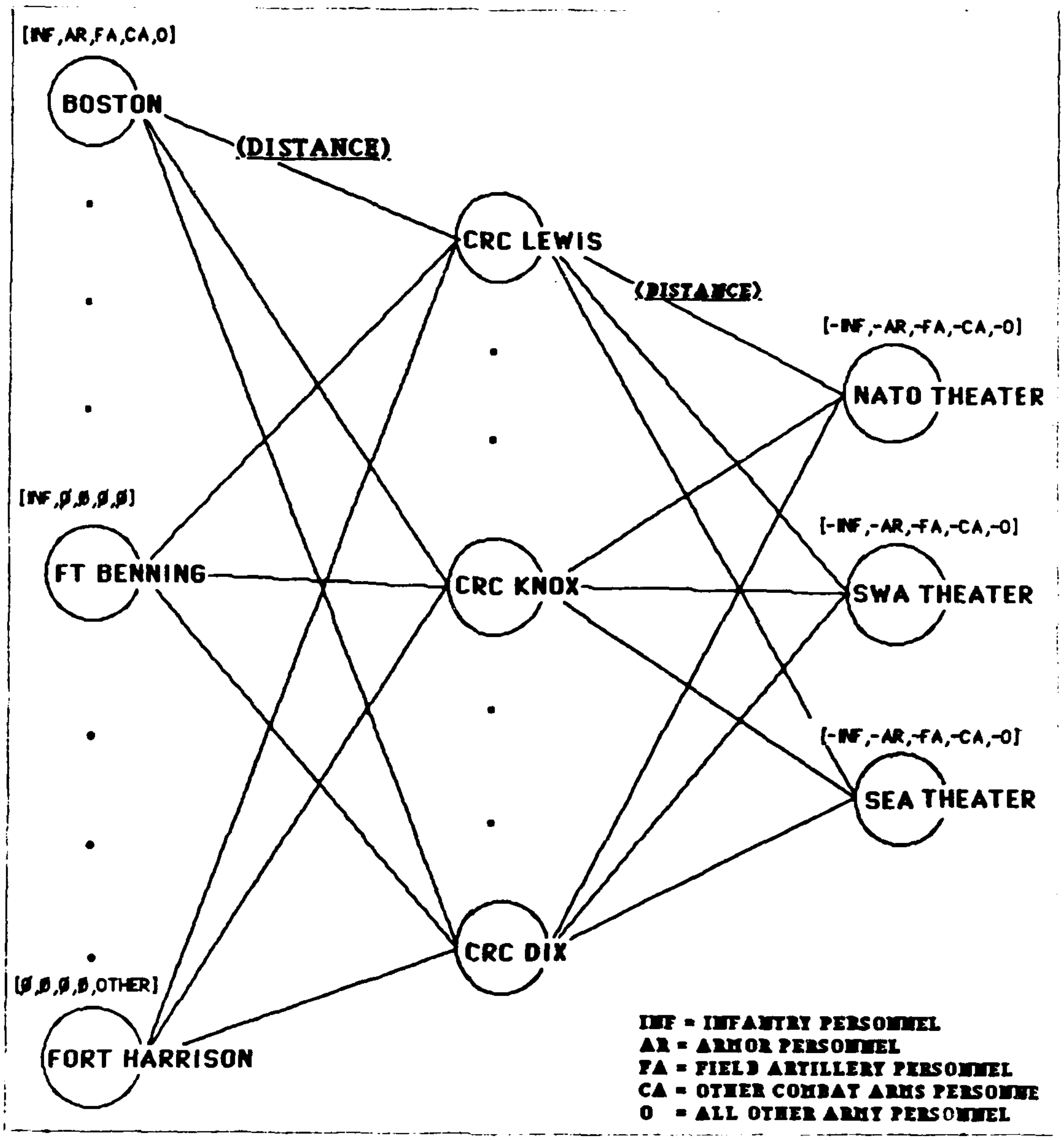


Figure 10. Multi-Commodity Minimum Cost Network Flow Problem

simplex partitioning. Through an iterative process, NETSID will solve the assigned problem by identifying the flow which minimizes the total cost, subject to the satisfaction of the nodal conservation of flow constraints, the applicable side constraints and the desired nonnegativity constraints (22:1).

The assigned problem can consist of a variety of types and sizes as long as the problem can be written in the mathematical format shown in Appendix P. If the problem does not have side constraints, it is solved as a minimum cost network flow problem. If the problem consists of side constraints but no nodal conservation of flow constraints (which make up the incidence matrix), it is simply a general linear programming problem and is solved accordingly (22:1).

As an indication of its robustness, NETSID has solved problems with up to 30,000 arcs (22:9). However, indications are that NETSID is at its best when the number of rows in the incidence matrix is about ten times as large as the number of side constrains. When this has occurred, NETSID has been shown to be significantly more efficient (twice as fast in solving the problem) than general linear programming systems such as MINOS, XMP and LISS (24).

To solve any multi-commodity, multi-period minimum cost network flow problem with NETSID, each commodity for each period has to be represented by an isolated network. The side constraints are then used to tie the individual networks together.

Since it was assumed, in this thesis, that all soldiers require about the same amount of time to process regardless of their MOS, the only concern in the design of the model's CRC was that the total number of replacements during a period did not exceed the CRC capacity. Thus, side constraints were used to insure that the flow into a specific, modeled CRC, regardless of its commodity network, did not exceed the capacity of that CRC.

Therefore, in this replacement system model, the theater demands were satisfied by the fixed external flows. The capacities of the CRCs were not exceeded by satisfying the side constraints. And, only positive flow occurred on the arcs because of the satisfied nonnegativity constraints.

The mathematical representation of these conditions were included in the following problem formulation:

$$\text{MINIMIZE} \quad h1f1 + h2f2 + h3f3 + h4f4 + h5f5 \tag{1}$$

$$\begin{aligned} \text{s.t.} \quad & Ef1 && = b1 \\ & \quad Ef2 && = b2 \\ & \quad\quad Ef3 && = b3 \\ & \quad\quad\quad Ef4 && = b4 \\ & \quad\quad\quad\quad Ef5 && = b5 \end{aligned}$$

$$f1ij + f2ij + f3ij + f4ij + f5ij \leq cij \quad \text{(for all ij)}$$

$$0 < fkij \leq ckij \qquad \text{(for all ij)}$$

Where k is the commodity type, h is the cost in terms of miles associated with each arc, f is the amount of flow on an arc between two nodes, E is the incidence matrix and c is the capacity of the designated CRC.

Solving the Macro Model

Prior to running NETSID, two preliminary steps were required. First, four data files were constructed in accordance with the appropriate FORTRAN format. Second, parameters in the NETSID FORTRAN code were redimensioned to accommodate the problem.

In building the data files, the first file, FOR001.DAT, contained the fixed external flows for each node of each commodity network for a single period. Since NETSID will satisfy a demand through the use of slack nodes and since the number of replacements often lag behind the required demand, total theater demands were proportionately reduced as required so that the total source values equaled the total sink values. Appendix Q illustrates the required format for the FOR001.DAT file and shows a portion of the first period data as a sample.

The second file, FOR002.DAT, contained the distance in statute miles between each node of each commodity network for a single period. In total there were approximately 6000 lines of entries for this file. A discussion on format and a portion of the first period data for the FOR002.DAT file is found in Appendix R.

The third file, FOR003.DAT, contained the left hand side of the side constraint equations. Specifically, this included, by period, the sum of the flow on all arcs which lead into each of the individual CRCs. Again, format procedures and a sample from the first period data are found in Appendix R.

Finally, the fourth data file, FOR004.DAT, contained the right hand side of the eight side constraint equations. In this file, found in Appendix T, was the capacity of the specific CRCs and a "less than or equal to" sign code.

Embedded throughout the NETSID FORTRAN code are parameter statements which are used to set the dimensions of all of the arrays. Since the same parameter statements appear in all arrays, dimension modifications must be conducted in a global fashion. An explanation of the parameters and a listing of the values assigned to them are shown in Appendix U.

Once compiled and linked, the NETSID.EXE program was run. After 200+ iterations and only 10+ seconds of VAX 11/785 computer time, the results were found in an output file entitled FOR007.DAT. This file yields a printout of the input data, the number of iterations required to attain the solution, the objective function value, and the node to node flow used to attain that objective function. As an example, a portion of the first period results using the current CRC configuration are found in Appendix V.

Developing the Micro Model

With the micro model, the focus was on the flow of replacements through a typical CRC. Thus a simulation model representing a soldiers arrival, processing phase and a departure was constructed using the SLAM II simulation language. An abbreviated depiction of the CRC processing procedures is shown in Figure 11 and a complete copy of the code is found in Appendix W.

Since the MOS category was not a factor in CRC processing, the SLAM create nodes did not differentiate between commodity types but instead created entities in a manner that best represented their expected arrival rate. The number of "soldiers" created each day was based on the same data used in the macro model; however, the daily arrival rate at the CRC had to be estimated.

Since the majority of both commercial and private travel traditionally takes place during the day-time hours, it was assumed that the soldiers' daily arrival rate at the CRC was normally distributed with a mean of 1200 hours and a standard deviation of five hours. The only exception to this was the training base "soldiers". Since graduates from the training base would probably be transported early in the day and as a unit rather than individually, the mean and standard deviation for this category were changed to 1000 hours and four hours respectively.

These newly created "soldiers" were then distributed to the various CRCs. The exact number of CRCs and the percentage of soldiers each CRC receives is based on the results of the macro model.

Since the scenario called for mobilization to begin the same day of the first battle, the CRCs would not be

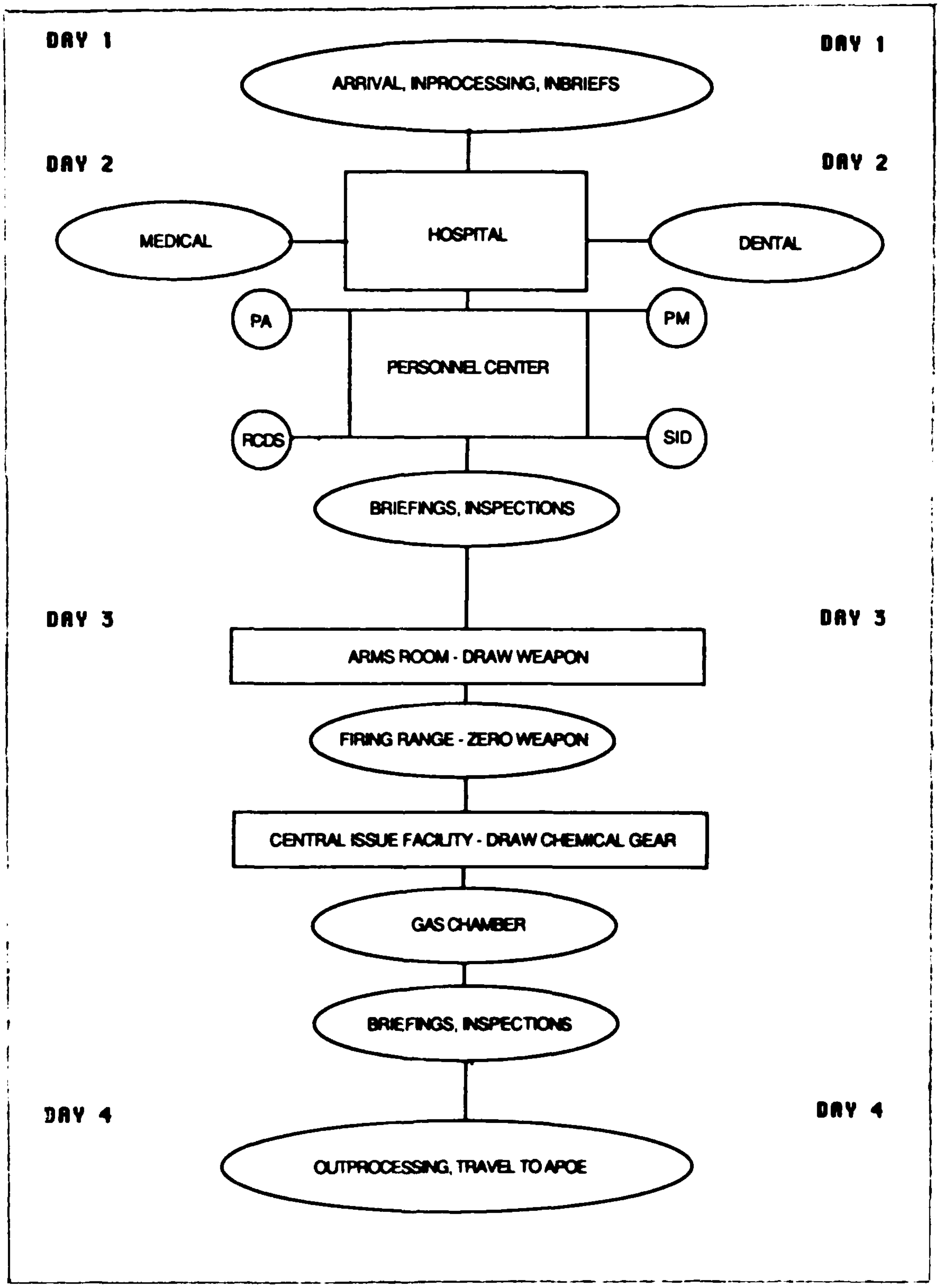


Figure 11. Typical CRC Processing Scenario

immediately operational. Thus, it was assumed that it would take five days to set up and get organized before the processing of "soldiers" would begin.

Some "soldiers" were further delayed as the CRCs reached capacity in that first 30 days. Those "soldiers" simply had to wait until others completed the processing.

The SLAM model used "unit" resources to restrict the number of "soldiers" that could begin the processing cycle, and used "cadre" resources to restrict the total number of "soldiers" that could be in the three day cycle at any one time. The available number of resources was based on the CRC size as dictated by the results of the macro model.

If both types of resources were available, "soldiers" could theoretically begin their processing. But since the individual "soldiers" arrive sporadically throughout the day, it is not constructive to schedule any major events. Therefore, the first day is dedicated to receiving, orienting and preparing the "soldiers" for the upcoming days of processing.

The second day began with a wake-up at 0500 hours and an hour for breakfast. In the early stages of the war, more time may be needed to feed all of the "soldiers", but for steady state conditions, these times were appropriate.

Following breakfast, the "companies" of "soldiers" were equally divided and sent either to the hospital or the Military Personnel Center (MILPO) for appropriate processing. At the MILPO, "soldiers" were further divided and assigned to one of the four section of the MILPO. The Records Branch was responsible for updating and reconstructing the personnel records, and verifying requirements for a series of items to include the following: 1) training, 2) overseas orientations, 3) remaining service obligations, 4) sole surviving son or daughter status, 5) security clearances, 6) emergency notification cards, and 7) identification tags and cards. Similarly, the Personnel Actions Branch was responsible for the correction of any personnel issues. The Personnel Management Branch was responsible for management in terms of MOS, rank, assignments and orders. Finally, the SIDPERS Interface Branch maintains the Army personnel data base.

Similarly, at the hospital, the "soldiers" were split between medical and dental processing. Accordingly, checks were made to insure that all inoculations had been received, profile requirements were met, current medical and dental examinations had been conducted, and any remaining examinations were scheduled and conducted.

In the case of these and all other processing activities, the SLAM II function USERF(INF) was used so that future modelers could easily access and modify the duration of these activities (23:298). Within each USERF function, a few preliminary estimates and calculations were made prior to establishing the activity durations.

First, the total amount of time available in one day to process all of the "soldiers" through an activity was established. Second, the amount of time required for one server to process one soldier through that same activity was estimated. Third, these figures dictated the number of servers required at each activity. Fourth, all of the above mentioned values were used in calculating the time, Z, in which a "platoon" would be processed through that activity. Finally, the assumption was made that the total processing time per "platoon" would be normally distributed with a mean of Z hours and a standard deviation of about ten minutes.

To insure meals were served at appropriate times, "gates" opened and closed the dining facilities in a realistic manner. Once a "platoon" finished with the MILPO (hospital), it was allotted time for the lunch meal and was subsequently queued at one of the section in the hospital (MILPO). The remainder of the day consisted of additional processing, an evening meal, briefings and inspections. Again, all of the daily activities were timed accordingly so that each "soldier" received an appropriate amount of sleep.

The third day was similar with the exception that the round robin stations were at the arms room for the drawing of individual weapons, at the firing range for the zeroing of individual weapons, at the Central Issue Facility for the drawing of chemical clothing and equipment, and finally at the gas chamber to test the gas mask. Again, duration times for each of these activities were calculated in the manner stated above. Additionally, times for travel and maintenance was estimated and included in the model.

The fourth and final day marked the end of the CRC processing routine. "Soldiers" received final instructions, were transported to the appropriate APOE and the simulation was terminated.

Solving the Micro Model

After compiling and linking, the CRC.EXE program was run and the results were found in the CRC.LIS output file. Included in the output were the server and resource utilization rates and the time-in-system statistics. However, since the micro model is to serve only as a tool for future CRC management, and since most of the parameters were "soft" estimates, a detailed design of the experimental process was not carried out.

Verification and Validation

Before confidence could be placed in the output of these models, it was required to show that the designed models not only reflected that which was conceptualized, but also that which occurs in reality. To do this involved the processes of verification and validation.

Verification Verification is "the comparison of the conceptual model to the computer code that implements that conception" (1:376). In the case of both the macro and the micro model, this verifying comparison was accomplished in a variety of ways.

First, other analysts checked the codes and data files to insure they did what the author indicated. Second, checks on the model's output were conducted throughout the entire building and sensitivity analysis phases to insure that the results were reasonable under a variety of differing variable settings. Third, the use of flow diagrams graphically aided in the correct design of entity flow. Finally, thorough code documentation throughout the model helped insure that the appropriate action were occurring at the appropriate time (1:379).

Validation Validation is the "... process of determining that a model is an accurate representation of the real system" (1:377). Since the CRC, the "real system", does not exist during peacetime conditions, this determination is difficult to establish. However, by incorporating the knowledge gained from previous war's processing centers and from the recent CRC exercise, analysts at the Soldier Support Center have found the output from both models to possess the required structural and "high face validity" (1:385).

IV. Findings and Analysis

In the following sections, the discussion evolves around the macro model's output under the current CRC configuration, the macro model's output under a reduced CRC configuration and the effects of this reduced CRC configuration on the micro model. The chapter concludes with an analysis of the models' output in terms of the research objective.

Current CRC Configuration

Given the CRC sizes (Appendix A), the fact that each replacement company in the CRC can complete the processing of 400 soldiers each day (3:A-2), and the fact that a soldier takes approximately three days to complete the cycle, the total output of the eight CRCs for a 30-day period is about 360,000 replacements.

By comparing these 30-day period capabilities with the period totals for replacement supply and demand figures from previous appendices, Figure 12 vividly points out the fact that the capabilities of the current CRC configuration far exceeds that which will ever be required.

Of even greater importance is the lack of utilization of the CRC cadre and the host installation facilities. Figure 13 graphically illustrates the low utilization rate of the eight CRCs over the entire 180 day process. On the other hand, the advantage of this configuration was that the

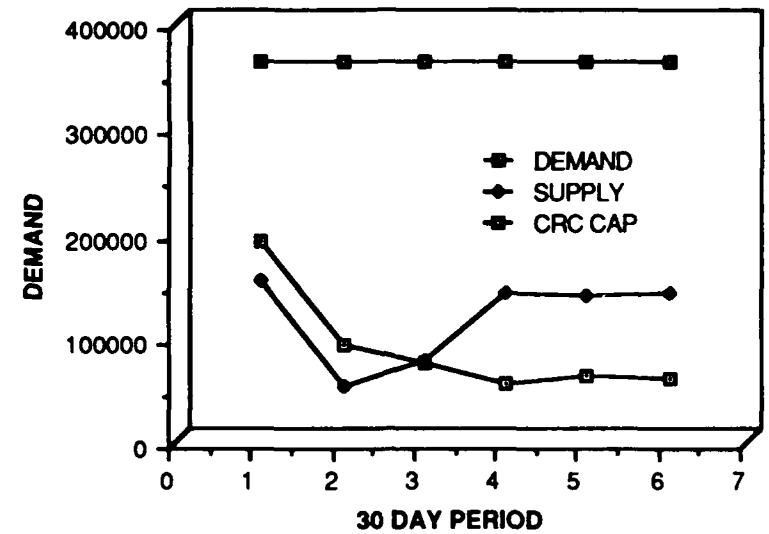


Figure 12. CRC Capacity vs. Supply vs. Demand

average number of miles the soldier travelled was a low value of 4,946 miles.

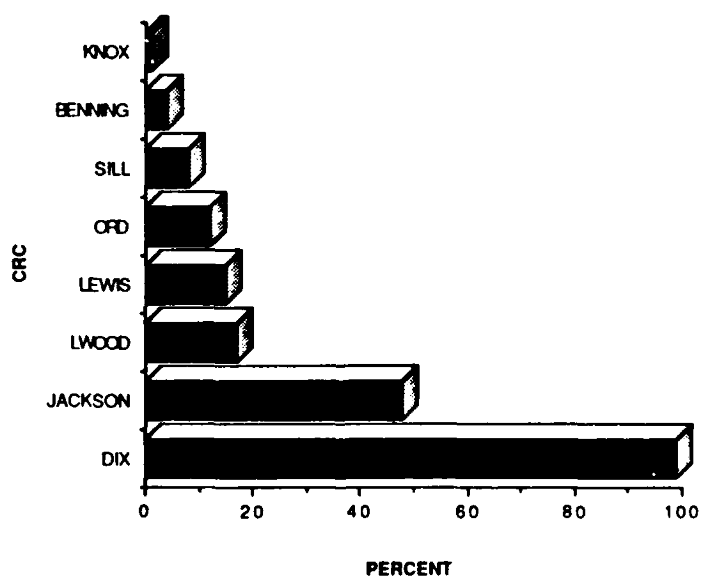


Figure 13. Utilization Rate of the Current CRC Configuration

It seems clear that a compromise on the number of CRCs can be made. A large number of CRCs would require the soldiers to travel the least number of miles, but the waste of resources at the CRC and the installation is so high that it demands a reduction.

Reduced CRC Configuration

Since our goals are to minimize the distance the soldiers must travel and, secondarily, minimize the total number of CRCs, it is necessary to conduct some sensitivity analysis to determine how a reduction in CRC capability would affect the total number of miles travelled. Because the overall CRC processing capability is a function of both the number of CRCs and the size of each individual CRC, a stepwise reduction of both variables was appropriate.

Based on obvious command and control restrictions, the CRC structure should consist of a replacement battalion with no less than two and no more than six replacement companies (3:C-1). Thus, in this sensitivity analysis, the number of replacement companies per CRC ranged from two to six.

Similarly, the size of the CRCs dictated the total number of CRCs which was required to meet the replacement demand. Therefore, the analysis started with eight CRCs and incrementally reduced the number down to three.

Due to the fact that the first 30 days was the most time sensitive and the period which possessed the greatest demand for replacements, it was this period that the initial analysis evolved around.

For each run, the appropriate modifications to the CRC capabilities were made in the input files. The output then yielded the total miles travelled under those constraints. Total miles travelled divided by the total number of replacements processed that period resulted in the average distance travelled by each soldier. It is these distances that are recorded below in Table 1.

TABLE 1

Average Miles Travelled as a Function of CRC Size and Number (Period 1 Only)

	# Replacement Companies per CRC				
# CRCs	2	3	4	5	6
3				4876	4795
4			4880	4823	4795
5		4971	4876	4820	4793
6		4966	4870	4814	4789
7	5172	4959	4870	4814	4786
8	5100	4958	4869	4814	4786

As expected, the results shown in Table 1 illustrate the obvious -- that the more capacity the system has the less the distance the soldier travelled.

Additionally, it is interesting to note that the average distance travelled was much more sensitive to the reductions in the number of replacement companies per CRC than to the reductions in the total number of CRCs. These observations make the point that some CRCs are more important than others, and that these more important CRCs should be as large as possible.

A number of techniques could be used to determine which CRCs are most important. For example, a branch and bound technique would be ideal in determining the most significant CRCs because all CRC interdependencies would be considered. But, for the purpose of this study, a simplified heuristic was appropriate. Thus, it was assumed that the CRC with the smallest 180-day utilization rate was the CRC which would least affect the total distance travelled.

However, to establish the relative importance of the CRCs, it was necessary to reduce the size of the CRCs, relative to the number of CRCs, to the point where total capacity is about equal to the total demand. By doing so, the largest CRC, Fort Dix, did not consume all of the replacements and this allowed other CRCs to participate.

In Figure 14, the utilization rate for the original eight CRCs are again shown. However, in this case, the size of each of the CRCs was decreased to three replacement companies. From this figure, it was obvious that the CRCs at Forts Benning, Knox and Ord were not sufficiently utilized. Thus, they were eliminated from further consideration.

Runs were then conducted with the remaining five CRCs. Again, the number of companies remained at three per CRC. The results of these runs are shown in Figure 15.

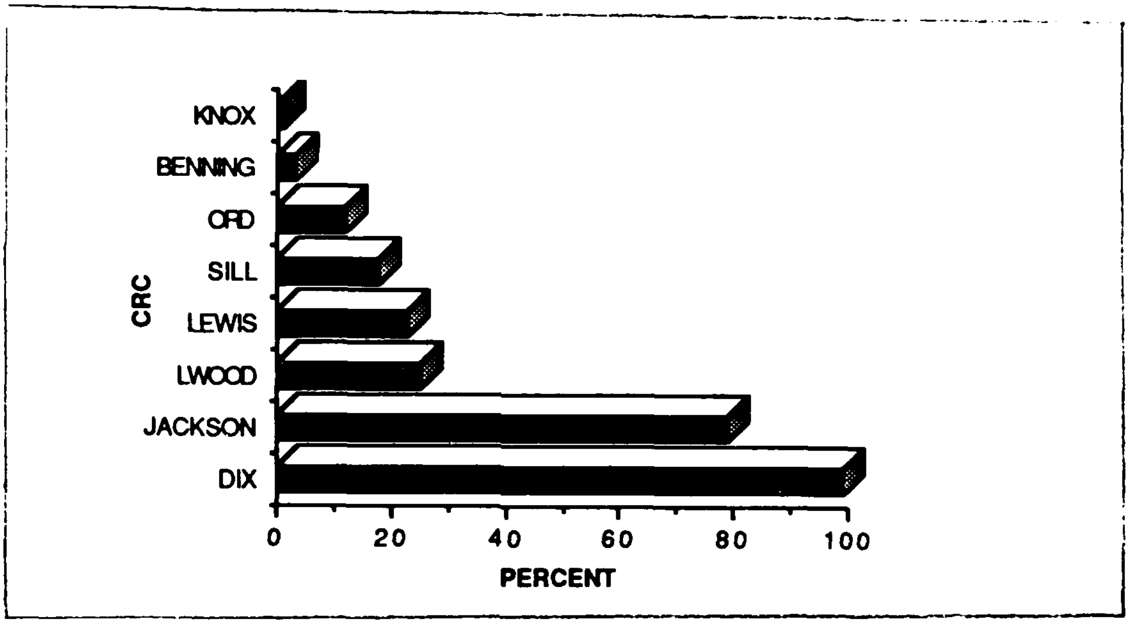


Figure 14. Utilization Rates of Eight CRCs with Three Replacements Companies Per CRC

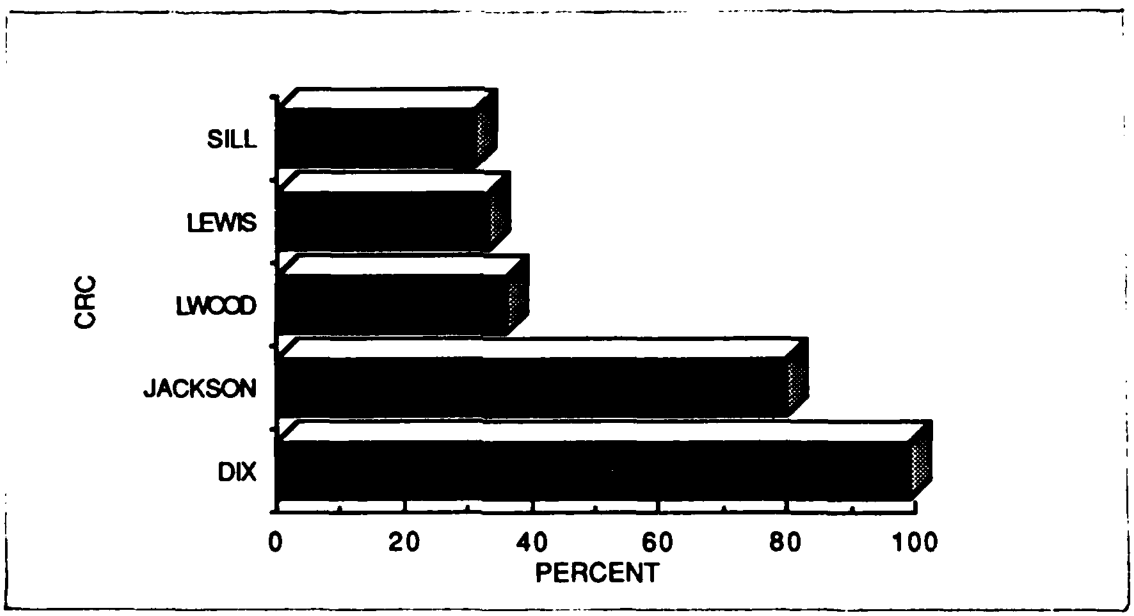


Figure 15. Utilization Rates of Five CRCs with Three Replacement Companies Per CRC

As expected, the results indicated an overall improvement in utilization rates but also indicated that Fort Sill was the least significant of these five CRCs.

In the next series of runs, only four CRCs were considered, and each of these had four replacement companies. The results, in terms of overall utilization rates, are shown in Figure 16.

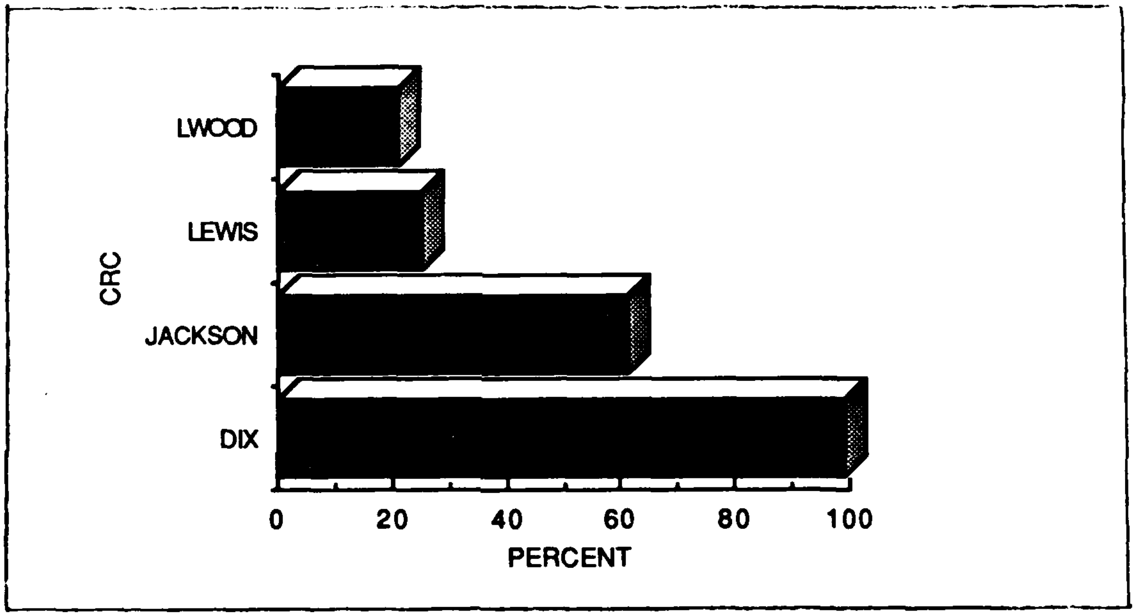


Figure 16. Utilization Rates of Four CRCs with Four Replacement Companies Per CRC

Although Fort Leonard Wood played an important role in the replacement process, the results in this figure indicate that it is the least significant, and therefore should not be considered in future analysis. Thus, a final series of runs were made with only three CRCs. This time, the number of replacement companies was five for each CRC. The resulting utilization rates are shown in Figure 17.

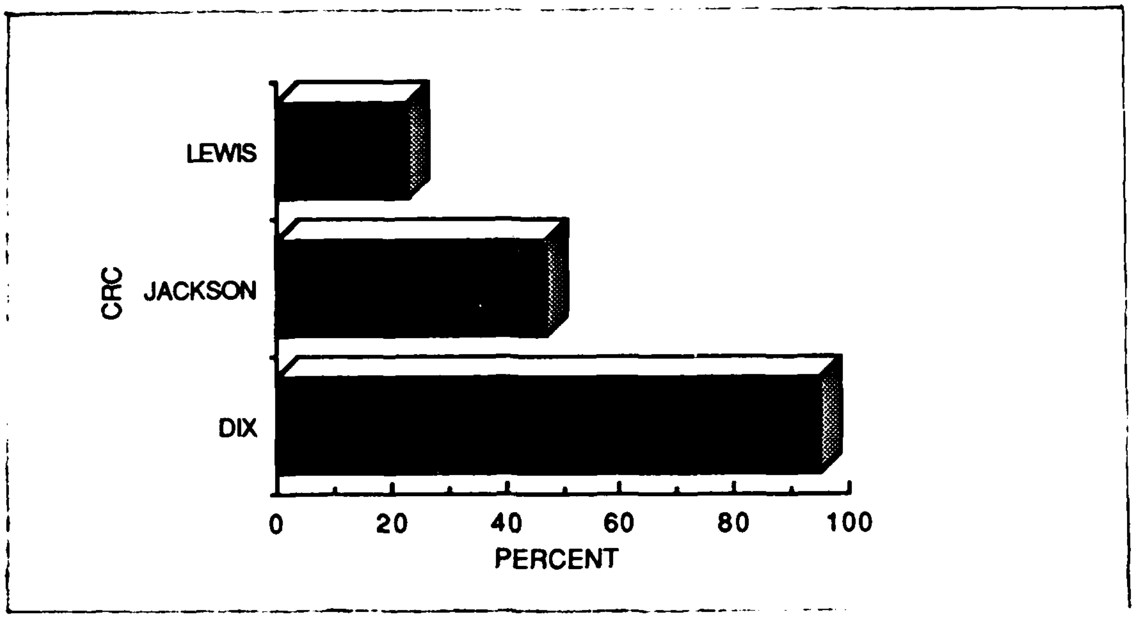


Figure 17. Utilization Rates of Three CRCs with Five Replacement Companies Per CRC

Based strictly on demand, it could be said that a CRC at Forts Lewis, Jackson and Dix would be sufficient. However, as shown in the last column of Table 1, these reductions caused the average distance to increase by 9 miles (period 1 only). With this in mind, the next step was to determine the number of replacement companies each of these CRCs should possess.

CRC Sizes

In an attempt to save on resources, the desire was to reduce the size of each CRC without increasing the average miles travelled. Again, the analysis used data from the first period because it was the period with the greatest demand. Since any reduction in the number of Fort Dix CRC replacement companies caused an increase in distance travelled, only the significant portions of these results are shown in Table 2.

TABLE 2

The Effect of CRC Size on the Average Miles Travelled (Period 1 Only)

# Replacement Companies			Average Miles
Dix	Jackson	Lewis	Travelled
6	6	6	4795
		5	4795
		4	4795
		3	4795
		2	4796
	5	6	4795
		5	4795
		4	4795
		3	4795 *
		2	4796
	4	6	4851
		5	4851
		4	4851
		3	4851
5	6	6	4830
		5	4830
		4	4830
		3	4830
		2	4831
	5	6	4876
		5	4876
		4	4876
		3	4876

As illustrated in this table, both the average miles travelled and the total number of replacement companies were minimized when the number of companies for Forts Dix, Jackson and Lewis was six, five and three respectively.

Similar analysis was conducted with data from the remaining five periods to insure that this configuration continued to meet the replacement demands. In each case, the results were the same.

Micro Model Modifications

Given this reduced CRC configuration, corresponding changes were made to the micro model. First, the total number of CRCs was reduced from eight to three. Second, the percentage of the replacements each CRC received was based on the CRC's size. Thus, 43% of the created "replacements" were assigned to the Fort Dix CRC, 36% were assigned to the Fort Jackson CRC and the remaining 21% were assigned to the Fort Lewis CRC. Finally, the number of resources was modified to match the size of the various CRCs. Since the duration of the service activities was based on individual processing rates, these values were the same for all CRCs and thus were not in need of change.

Application to the Research Objective

Recall that the objective of this research was to evaluate how well alternative CRC concepts, in terms of numbers, location, size and function, satisfy the Army's wartime replacement requirements. With the above-mentioned modifications, the micro model fully addressed the functional aspect of the overall research objective. The remaining issues of this research objective were all addressed with the results of the macro model.

During the sensitive analysis, it was determined that a minimized CRC configuration consisting of a Fort Dix CRC with six replacement companies, a Fort Jackson CRC with five replacement companies, and a Fort Lewis CRC with three replacement companies could meet the processing demand for replacements.

However, although the number of CRCs was drastically reduced and a better CRC utilization rate was attained, it was not without cost. The primary objective, to minimize the distance soldiers had to travel, was not kept at its minimal level. In fact, the reduced configuration actually increased the average distance travelled by approximately 46 miles (all six periods considered).

Before the conclusion could be made that 46 miles was an insignificant gain with respect to the resources saved, it was necessary to determine what an increase in the average distance travelled entails. To do this, an example follows which illustrates the effects of a single mile increase.

The current CRC configuration was run with data from the sixth period. Then to force a one mile increase in the overall distance travelled, the 30-day capacity of the Fort Dix CRC was reduced from 60,000 to 59,500 soldiers and the sixth period data was run again.

This capacity reduction forced approximately 400 Infantry replacements from the Nashville geographic area and

100 Field Artillery replacements also from the Nashville area to be processed at Fort Jackson rather that at Fort Dix. By doing so, each of these soldiers travelled 390 miles less. However, the flight from Fort Jackson to the NATO theater was 650 miles farther than it would have been from Fort Dix. Thus, the end result was that on a daily basis about 17 soldiers (500 soldiers per period divided by 30 days per period), enroute from Nashville to Paris, each travelled an extra 250+ miles.

Therefore, since the additional amount of time required to fly 4750 miles rather than 4500 miles was relatively minimal, the conclusion was made that 46 additional miles over 180 days was not significant when compared to the improvements in utilization rates and the overall savings in resources. Thus, a reduced CRC configuration appears to be more efficient and effective than the current CRC configuration of eight CRCs. However, under the realistic conditions of global conflict, is the minimal configuration necessarily the configuration that best satisfies the theaters' demands?

V. Implications, Refinements and Conclusion

Although the minimal CRC configuration has some inherent advantages, practical implications indicate that there may yet be a better configuration. In this final chapter, those implications will be addressed, along with recommendations for the refinement of the models, and finally, a conclusion to this research effort.

Practical Implications

Under ideal conditions, the minimal CRC configuration can more than adequately meet the Army's replacement needs; however, actual conditions are far from ideal, especially during a time of war. Practically speaking, arguments for supplementing the minimal CRC configuration involve four separate topics.

First, in a hostile environment, contingency plans are essential. Needless to say, a minimal CRC configuration does not allow for sufficient backup capability. As a case in point, if the Fort Dix CRC, the largest of the three CRCs, were to be annihilated in an enemy bombing raid, the replacement processing capability would be severely reduced. This in turn would result in heavy backlogs at the remaining two CRCs, it would significantly increase the average distance the soldiers would have to be transported and, most importantly, it would cause major delays in the arrivals of replacements in the theaters of operation.

Even if this worst case scenario did not occur, there is still a definite need for depth in the system. For example, if Fort Dix were to simultaneously receive and host a large number of reserve units enroute to the theaters, which is highly probable, the various resources of that installation would be severely stretched. This would wreak havoc with the timely and continuous flow of replacements to the theaters.

Second, in the unlikely event that the members of the CRCs have access to all of the resources they initially require, there is doubt as to their ability to maintain the required level of activity over an extended period of time. Due to a variety of reasons, the CRC cadre and the members of the installation support facilities are destined to experience a degradation in their performance within a matter of a few weeks, if not days (15:1-4). This decaying effect on processing performances is still another reason for supplementing the minimal CRC configuration.

Since the facilities that a CRC would require are, for the most part, already present at a variety of military installations, the cost to open an additional CRC is limited to the personnel costs required to man this CRC. For all intents and purposes, the overhead costs are insignificant. The tradeoffs of increased personnel costs versus added processing capabilities are worthy of additional analysis and certainly add credence to a third argument for a larger configuration.

A possible fourth implication could involve the APOE location. Since it is not unusual for commercial facilities to provide support to the military during a time of war, it is not unrealistic to consider relocating the APOEs to the metropolitan airports which are closest to the CRCs. The effects of these concept modifications may indeed be a determining factor in the final analysis and thus are deserving of additional research.

Recommendations for Model Refinement

Aside from the incorporation of these real world implications into the designed models, some fine tuning of the current codes may add more credibility to the output, and ultimately improve the models' usefulness to the decision maker. With this in mind, four refinement recommendations are discussed below.

The first concern lies at the heart of the macro model, its objective function. Although minimized distance is an adequate measure of the effectiveness of a replacement system, the real issue is how well the system responds to the demands of the theaters. This obviously involves not only timeliness but also proper emplacement of the soldier. A refinement to the macro model's objective function so that it minimizes the time required to get the right replacement to the right combat unit is ultimately the answer. However, this type of objective function appears to be feasible only after significant analysis is conducted in the areas of replacement supply and demand.

A second recommendation for model refinement involves the marginal cost of establishing and operating an additional CRC. Obviously, there are numerous, unspecified financial obligations in the manning and utilization of military facilities that should be included in the models. Thus, if these costs could be estimated, the models would be much more useful in analyzing the tradeoff between an increased capability and an increase in the distance a soldier travelled.

The third refinement involves improved model data. Because the CRC is a product of war, limited data regarding its detailed operation is available. However, with each training exercise involving the replacement system and its associated CRCs, invaluable knowledge is gained. With this, estimates in the areas of replacement source output, processing times and theater demand figures could be significantly improved. Additionally, further verification and validation of the models would be possible which in turn would improve the accuracy of the models' output.

In a similar vein, the final refinement would include an accurate assessment of the available resources and competing alternatives. A thorough understanding of these resources permits for the elimination of simplifying assumptions that reduce the usefulness and quality of a model. Simultaneously, it allows for the inclusion of constraints in the model's structure which assist in the attainment of more accurate results.

Conclusion

If the immediate inclusion of these implications and refinements was feasible, the conclusion would, in all probability, call for a CRC configuration which was reduced but not minimized. Therefore, it is recommended that the current CRC configuration be reduced from eight CRCs to five CRCs. The five CRCs should be located at Forts Dix, Jackson, Lewis, Leonard Wood and Sill; and each should possess six replacement companies (based on the results of Table 1). Soldiers to be processed should be distributed to the CRCs in the prioritized order of Dix, Jackson, Lewis, Leonard Wood, and Sill. By doing so, the total distance travelled will be kept to a minimum. This reduced configuration would in turn be more realistically responsive to the replacement demands and it would simultaneously reduce the overall resource costs.

Appendix A: Current CRC Concept

CRC	# of Replacement Companies	APOE	Distance from APOE
Fort Lewis	5	McChord AFB	10
Fort Ord	3	Travis AFB	150
Fort Sill	3	Little Rock AFB	410
Fort Leonard Wood	3	Little Rock AFB	480
Fort Knox	3	Little Rock AFB	840
Fort Benning	3	Charleston AFB	380
Fort Jackson	5	Charleston AFB	110
Fort Dix	5	McGuire AFB	0

Number of replacements processed during a 30-day period at the Forts Lewis, Jackson, and Dix CRCs:

(400 soldiers/co/day)*(30 days/pd)*(5 co) = 60000 soldiers

Number of replacements processed during a 30-day period at the remaining CRCs:

(400 soldiers/co/day)*(30 days/pd)*(3 co) = 36000 soldiers

Appendix B: NATO Personnel Demands

(Casualties - In theater RTD = CRC Demands)

Period	Inf	AR	FA	CA	Other
1	41447	16482	6099	25823	47305
	-6351	-2752	-1496	-5229	-18532
	35096	13703	4603	20594	28773
2	32092	12529	4999	20153	41539
	-9084	-3639	-2130	-7057	-23788
	23008	8890	2869	13096	17751
3	26006	9927	4453	17147	39861
	-8571	-3313	-2319	-7074	-25980
	17435	6614	2134	10073	13881
4	23813	9101	4261	15959	39351
	-2365	-3620	-2509	-7656	-28147
	14448	5481	1752	8303	11204
5	23487	8976	4319	15664	39329
	-7218	-2806	-2212	-6298	-25827
	16269	6170	2107	9366	13502
6	20097	7695	3953	13841	37753
	-8803	-3412	-2491	-7338	-28373
	11294	4283	1462	6503	9380
	34.7%	13.3%	4.4%	20.0%	27.6%

Appendix C: SWA Personnel Demands

(Casualties - In theater RTD = CRC Demands)

Period	Inf	AR	FA	CA	Other
1	2385	1058	502	1243	3237
	-357	-106	-139	-322	-2014
	2028	952	363	921	1223
2	1556	625	361	883	3052
	-707	-218	-201	-489	-2539
	858	407	160	394	513
3	661	187	190	486	3277
	-692	-202	-205	-501	-2816
	-31	-15	-15	-15	461
4	1308	493	322	786	3241
	-560	-138	-182	-442	-2800
	748	355	140	344	441
5	1053	374	271	660	3058
	-547	-133	-179	-435	-2764
	506	241	92	225	294
6	767	243	216	530	2822
	-531	-130	-174	-422	-2681
	236	113	42	108	141
	36.9%	17.7%	6.6%	16.9%	22.0%

Appendix D: SEA Personnel Demands

NATO MOS Breakdown:
34.7% - INF
13.3% - AR
4.4% - FA
20.0% - CA
27.6% - Other

Period	Casualties	RTD	Demand	MOS Breakdown
1	14789	7251	7538	2616 - INF
				1003 - AR
				332 - FA
				1507 - CA
				2080 - O
2	32049	14617	17432	6049
				2318
				768
				3486
				4811
3	33872	16549	17323	6011
				2304
				768
				3486
				4811
4	28046	16491	11553	4010
				1537
				508
				2311
				3189
5	24939	17955	6989	2423
				929
				307
				1397
				1928
6	22977	17349	5628	1953
				749
				248
				1126
				1552

Appendix E: Training Base Output by MOS and Period

Installation	Period 1	2	3	4	5	6
INFANTRY						
Benning	2628	2628	2867	3823	5256	6929
Jackson		1416	1593	4425	4779	5487
Polk			341	1728	3085	7407
Dix				2616	3020	5015
Bragg				1953	2555	5543
Lewis				1255	3105	5110
Ord					1882	3982
Campbell					861	4100
ARMOR						
Knox	2408	3853	4335	4816	4810	4800
Bliss					3924	4000
Hood					3924	4000
FIELD ARTILLERY						
Sill	2039	2040	2855	4282	4290	5098
Hood					840	3300
OTHER COMBAT ARMS						
Leonard Wood	1170	1170	1317	1610	4098	5269
Belvoir	10	10	10	10	10	10
Bliss	1500	1500	1500	1500	1500	1500
Bragg	300	300	300	300	300	311
Sam Houston	110	110	110	100	100	100
ALL OTHER ARMY MOSs						
Sam Houston	3192	4104	5472	7296	10032	15504
Lee	2500	2500	2500	2500	2500	2500
Gorden	1780	1780	1780	1780	1780	1780
Deven	100	100	140	145	231	330
Hood	415	415	415	415	415	415
APG	750	750	750	750	750	750
Sill	350	350	350	350	350	350
Bliss	85	85	85	85	85	85
Knox	420	420	420	420	420	420

Installation	Period 1	2	3	4	5	6
ALL OTHER ARMY MOSs (cont)						
Leonard Wood	1700	1700	1700	1700	1700	1700
Belvoir	675	675	675	675	675	675
McClellan	806	810	907	1109	2822	3629
Dix	685	685	685	685	685	685
Jackson	1740	1740	1740	1740	1740	1740
Ord	725	725	725	725	725	725
Eustis	950	950	950	950	950	950
Rucker	230	230	230	230	230	230
Benjamin Harrison	730	730	730	730	730	730
Monmouth	150	150	150	150	150	150
Bragg	20	20	20	20	20	20
Redstone	750	750	750	750	750	750
Monroe	250	250	250	250	250	250
Misc	200	200	200	200	200	200

Appendix F: CONUS Return-to-Duty Personnel by MOS and Period

Period	CONUS RTD	CONUS RTD by MOS* INF	AR	FA	CA	Other
1	435	153	58	19	87	120
2	7073	2454	941	311	1415	1952
3	20693	7180	2752	910	4139	5711
4	31336	10873	4168	1379	6267	8641
5	28227	9795	3754	1242	5645	7791
6	34154	11851	4542	1503	6831	9427

* NATO MOS Casualty Percentages

34.7% - INF
13.3% - AR
4.4% - FA
20.0% - CA
27.6% - Other

Appendix G: Available Personnel in the RT-12 Category Listed by MOS and Period

Period	RT-12 estimates	RT-12 estimates by MOS*				
		INF	AR	FA	CA	Other
1	44250	5421	2544	3208	3761	30311
2	8250	1011	473	598	701	5651

* Current Army MOS Distribution

12.3% - INF
5.4% - AR
7.3% - FA
8.5% - CA
66.5% - Other

Appendix H: Available TDA Personnel by MOS and Period

Period	TDA estimates	TDA estimates by MOS* INF	AR	FA	CA	Other
1	56686	6944	3259	4110	4818	38830
2	7213	884	415	523	613	4941

* Current Army MOS Distribution

12.3% - INF
5.4% - AR
7.3% - FA
8.5% - CA
66.5% - Other

Appendix I: Transient, Holdee and Student Account by MOS and Period

Period	THS estimates	THS estimates by MOS* INF	AR	FA	CA	Other
1	12419	1521	714	900	1056	8507

* Current Army MOS Distribution

12.3% - INF
5.4% - AR
7.3% - FA
8.5% - CA
66.5% - Other

Appendix J: Personnel on CONUS Leave by MOS and Period

Period	CONUS LV estimates**	CONUS LV estimates by MOS* INF	AR	FA	CA	Other
1	8200	1005	472	595	697	5617

* Current Army MOS Distribution

12.3% - INF
5.4% - AR
7.3% - FA
8.5% - CA
66.5% - Other

** CONUS Leave Calculations

NATO:
1/3 * 250000 * 1/12 = 6950

SEA
1/4 * 60000 * 1/12 = 1250

8200 soldiers

Appendix K: Distances Between CRC and APOD via APOE

CRC	Paris	Cairo	Tokyo
Lewis	5030	6860	4800
Ord	5760	7660	5370
Sill	5310	7310	6710
Leonard Wood	4950	6940	6810
Knox	5060	7060	7400
Benning	4830	6810	7290
Jackson	4330	6300	7060
Dix	3680	5660	6750

(Distances are in statute miles)

Appendix L: U.S. Geographic Divisions and Associated Population Centers

Division	States	%	Pop Center
New England	MN NH VT MA RI CN	5.3%	Boston
Mid Atlantic	NY NJ PA	15.7%	New York City
E North Central	OH IN IL MI WI	17.6%	Chicago
W North Central	MN IA MO ND SD NB KS	7.4%	Omaha
South Atlantic	DE ML DC VA WV NC SC GA FL	16.7%	Columbia
E South Central	KY TN AL MS	6.4%	Nashville
W South Central	AR LO OK TX	11.1%	Dallas

Division	States	%	Pop Center
Mountain	MT ID WY CO NM AR UT NV	5.3%	Salt Lake City
Pacific	WA OR CA	14.5%	San Francisco

(AK and HI not included - 0.5%)

Appendix M: Distances Between Population Centers and CRCs

Center	Lewis	Ord	Sill	LWood	Knox	Bnning	Jacksn	Dix
Boston	2989	3185	1734	1253	951	1151	893	281
NYC	2818	3014	1540	1059	757	953	695	83
Chicago	2021	2226	869	388	290	767	763	781
Omaha	1645	1767	542	393	689	1029	1167	1231
Columbia	2784	2641	1127	799	480	279	0	628
Nashville	2379	2261	747	366	169	326	433	818
Dallas	2082	1687	187	530	820	737	1014	1475
Salt Lake	845	839	1099	1279	1578	1915	2053	2159
San Fran	778	113	1606	2025	2324	2481	2696	2905

Appendix N: Distances Between Army Training Centers and CRCs

Center	Lewis	Ord	Sill	LWood	Knox	Bnning	Jacksn	Dix
Polk	2358	1960	659	573	756	557	834	1364
Campbell	2307	2251	748	300	166	398	504	865
Hood	2115	1699	604	655	914	804	1081	744
Bliss	1713	1093	602	1066	1423	1354	1631	2074
Belvoir	2699	2871	1083	891	578	718	460	168
Sam Houst	2162	1657	394	800	1059	903	1182	1714
Lee	2786	2864	1126	929	571	595	332	296
Gorden	2763	2578	1064	750	496	215	68	695
Deven	2977	3173	1433	1241	939	1139	881	269
APG	2699	2878	1379	898	596	755	497	131
McClellan	2566	2354	840	536	366	126	307	856
Eustis	2831	2935	1179	982	624	654	377	309
Ben Harr	2199	2316	817	336	112	589	585	673
Monmouth	2830	3024	1525	1044	742	921	663	51
Redstone	2474	2274	760	450	263	229	380	856
Carson	1388	1313	579	786	1093	1391	1568	1730
Monroe	2848	2933	1197	1000	642	648	370	297
Bragg	2811	2790	1276	897	553	437	159	481
Rucker	2718	2429	923	699	558	100	357	982
Lewis	0	877	1944	2037	2311	2673	2784	2802
Ord	877	0	1515	1985	2342	2424	2641	2989
Sill	1944	1515	0	482	837	917	1127	1490
LWood	2037	1985	482	0	358	647	799	1009

Center	Lewis	Ord	Sill	LWood	Knox	Bnning	Jacksn	Dix
Knox	2311	2342	837	358	0	477	480	707
Benning	2673	2424	917	647	477	0	279	886
Jackson	2784	2641	1127	799	48	279	0	628
Dix	2802	2989	1490	1009	707	886	628	0

Appendix O: Host Installation Resources

CRC	# of Beds	Mess Hall Capacity	Firing Positions	Gas Chambers
Dix	17100	16800	1000	1
Jackson	23300	18400	1080	1
Lewis	16000	12500	1000	1
Ord	15500	11500	1000	1
Sill	20000	9500	1875	2
LWood	23400	12000	1725	1
Knox	18500	13600	1000	1
Benning	20000	15000	3000	2

NOTE: These resources will be used by both the training units and the CRCs.

Appendix P: NETSID Mathematical Format

NETSID is a FORTRAN code that solves networks with side constraints. Mathematically, these problems take the form:

$$\min \quad cx + dy \tag{1}$$

$$\text{s. t.} \quad Ax = r \tag{2}$$

$$Sx + Py \; (=,<,>) \; l \tag{3}$$

$$0 < x < u \tag{4}$$

$$0 < y < v \tag{5}$$

where A is a node-arc incidence matrix,
S is a general matrix,
P is a general matrix,
c is a vector of costs,
d is a vector of costs,
r is a rhs vector for the network,
l is a rhs vector for the side constraints,
u is a vector of upper bounds for the variables, and
v is a vector of upper bounds for the side constraint (22:1).

Appendix Q: FOR001.DAT Format and Example

File FOR001.DAT contains the data r, as shown in Appendix P. The FORTRAN format is I6, F10.2. The first six spaces are for node numbers and the next ten spaces are for fixed external flow values (negative values = sinks). An example of the first period data is shown below:

```
000001-0039868.00
000002-0002357.00
000003-0002728.00
0000120002236.00
0000130006647.00
0000140007450.00
0000150003133.00
0000160007069.00
0000170002710.00
0000180004698.00
0000190002244.00
0000200006138.00
0000210002628.00
000031-0016296.00
000032-0000964.00
000033-0001376.00
0000420000861.00
0000430002547.00
0000440002856.00
0000450001201.00
0000460002710.00
0000470001040.00
0000480001800.00
0000490000861.00
0000500002352.00
0000510002408.00
000061-0006395.00
000062-0000378.00
000063-0000634.00
      .
      .
      .
```

Appendix R: FOR002.DAT Format and Example

File FOR002.DAT contains the arc number, the node numbers to which it flows (both from and to), the arc capacity (-1 = unconstrained), and finally the cost associated with that arc. The FORTRAN format is 3I6, 2F10.2. An example of the first period data is shown below:

```
000001000004000001-0000001.000005030.
000002000004000002-0000001.000006860.
000003000004000003-0000001.000004800.
000004000005000001-0000001.000005760.
000005000005000002-0000001.000007660.
000006000005000003-0000001.000005370.
000007000006000001-0000001.000005310.
000008000006000002-0000001.000007310.
000009000006000003-0000001.000006710.
000010000007000001-0000001.000004950.
000011000007000002-0000001.000006940.
000012000007000003-0000001.000006810.
000013000008000001-0000001.000005060.
000014000008000002-0000001.000007060.
000015000008000003-0000001.000007400.
000016000009000001-0000001.000004830.
000017000009000002-0000001.000006810.
000018000009000003-0000001.000007290.
000019000010000001-0000001.000004330.
000020000010000002-0000001.000006300.
000021000010000003-0000001.000007060.
000022000011000001-0000001.000003680.
000023000011000002-0000001.000005660.
000024000011000003-0000001.000006750.
000025000012000004-0000001.000002990.
000026000012000005-0000001.000003190.
000027000012000006-0000001.000001730.
000028000012000007-0000001.000001250.
000029000012000008-0000001.000000950.
              .
              .
              .
```

Appendix S: FOR003.DAT Format and Example

The third data file contains first the row number of the side constraints, second the arc (column) number associated with that constraint, and finally the coefficient given to the arc (column) number in the side constraints. The FORTRAN format is 2I6, F10.0. An example of the first period data is shown below:

```
00000100002501.
00000200002601.
00000300002701.
00000400002801.
00000500002901.
00000600003001.
00000700003101.
00000800003201.
00000100003301.
00000200003401.
00000300003501.
00000400003601.
00000500003701.
00000600003801.
00000700003901.
00000800004001.
00000100004101.

      .
      .
      .
      .
```

Appendix T: FOR004.DAT Format and Example

The fourth data file contains row numbers of the side constraints, the right hand side associated with that constraint, and a letter designating constraint type (ie. L=less than or equal to). The FORTRAN format is I6, F10.2, A1. An example using the current CRC concept capacities is shown below:

```
0000010060000.00L
0000020036000.00L
0000030036000.00L
0000040036000.00L
0000050036000.00L
0000060036000.00L
0000070060000.00L
0000080060000.00L
```

Appendix U: NETSID Parameter Statements

A description of the parameters and the settings used in the macro model are shown below:

ZCOLM - number of columns in the code - 900.

ZNONZ - number of nonzeros in S and P - 900.

ZCANSZ - candidate list size - 8.

ZNODE - row dimension of A - 500.

ZNOTR - row dimension of S and P - 10.

ZNRNVT - reinversion frequency - 40.

ZETA - maximum number of eta's used to represent the inverse of the working basis - 100.

ZETAZ - number of nonzeros in the eta file - 300.

ZNBLCK - block size to be priced when the candidate list is being produced - 300.

ZJECT - number of columns in the pivot reject list - 250.

Appendix V: Macro Model Output From First Period Data

```
   1 -48890.00
   2  -5820.00
   3   -712.00
  12    628.00
  13   1861.00
  14   2086.00
  15    877.00
  16   1980.00
          .
          .
          .

1079   163   126         -1.      1200.
   4  1080          1.
1080   163   127         -1.      1000.
   5  1081          1.
1081   163   128         -1.       640.
   6  1082          1.
1082   163   129         -1.       650.
   7  1083          1.
1083   163   130         -1.       370.
   8  1084          1.
1084   163   131         -1.       300.
   1  60000.00L
   2  36000.00L
   3  36000.00L
   4  36000.00L
   5  36000.00L
   6  36000.00L
   7  60000.00L
   8  60000.00L
  N E T S I D

   ENTER REINVT  ITERATION    0
   ENTER CHEKQI  ITERATION    0
   ENTER REINVT  ITERATION   40
   ENTER REINVT  ITERATION   80
   ENTER REINVT  ITERATION  120
   ENTER REINVT  ITERATION  160
   ENTER REINVT  ITERATION  200
THE FOLLOWING ROUTINES CHECK THE SOLUTION
FOR CONSISTENCY

   ENTER CHEKQI  ITERATION  208
   ENTER FESCHK  ITERATION  208
   ENTER DUALCK  ITERATION  208

   OBJECTIVE FUNCTION VALUE  0.699432440E+09
```

OPTIMAL SOLUTION AT ITERATION 208

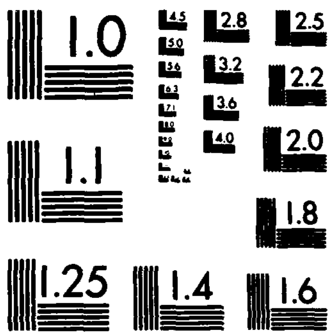
BASIC VARIABLES --- ARTIFICIALS HAVE NAME = 99999

INDEX	NAME	FROM	TO	VALUE
1	1	4	1	0.163600000E+04
2	2	4	2	0.582000000E+04
3	6	5	3	0.712000000E+03
4	81	19	4	0.628000000E+03
5	4	5	1	0.327000000E+04
10	19	10	1	0.231160000E+05
11	22	11	1	0.208680000E+05
12	32	12	11	0.628000000E+03
13	40	13	11	0.186100000E+04
14	48	14	11	0.208600000E+04
15	56	15	11	0.877000000E+03
16	63	16	10	0.198000000E+04
17	72	17	11	0.758000000E+03
18	79	18	10	0.131600000E+04
20	89	20	4	0.171800000E+04
21	107	21	10	0.692900000E+04
22	115	22	10	0.548700000E+04
23	123	23	10	0.740400000E+04
24	132	24	11	0.501500000E+04
25	140	25	11	0.554300000E+04
26	141	26	4	0.511000000E+04
27	150	27	5	0.398200000E+04
28	164	28	11	0.410000000E+04
31	207	36	31	0.400000000E+04
32	220	40	32	0.119100000E+04
33	206	35	33	0.274000000E+03
34	202	34	32	0.626000000E+03
35	290	50	35	0.274000000E+03
36	311	52	36	0.400000000E+04
40	219	40	31	0.720000000E+02
41	222	41	31	0.111800000E+05
42	232	42	41	0.241000000E+03
43	240	43	41	0.713000000E+03
44	248	44	41	0.799000000E+03
45	256	45	41	0.336000000E+03
46	263	46	40	0.759000000E+03
47	272	47	41	0.291000000E+03
48	279	48	40	0.504000000E+03
49	281	49	34	0.241000000E+03
50	289	50	34	0.385000000E+03
51	308	51	41	0.480000000E+04
53	324	53	41	0.400000000E+04
61	422	71	61	0.358400000E+04

62	402	64	62	0.114000000E+03
63	406	65	63	0.184000000E+03
64	481	79	64	0.800000000E+02
65	490	80	65	0.184000000E+03
66	407	66	61	0.509800000E+04
70	420	70	62	0.425000000E+03
71	423	71	62	0.496000000E+03
72	432	72	71	0.800000000E+02
73	440	73	71	0.236000000E+03
74	448	74	71	0.264000000E+03
75	456	75	71	0.111000000E+03
76	463	76	70	0.251000000E+03
77	471	77	70	0.700000000E+01
78	479	78	70	0.167000000E+03
80	489	80	64	0.340000000E+02
81	503	81	66	0.509800000E+04
82	516	82	71	0.330000000E+04
91	607	96	91	0.150000000E+04
92	620	100	92	0.266000000E+03
93	606	95	93	0.142000000E+03
94	602	94	92	0.121000000E+04
95	690	110	95	0.142000000E+03
96	719	113	96	0.150000000E+04
100	619	100	91	0.174300000E+04
101	622	101	91	0.915700000E+04
102	632	102	101	0.362000000E+03
103	640	103	101	0.107200000E+04
104	648	104	101	0.120200000E+04
105	656	105	101	0.505000000E+03
106	663	106	100	0.114100000E+04
107	672	107	101	0.437000000E+03
108	679	108	100	0.758000000E+03
109	681	109	94	0.362000000E+03
110	689	110	94	0.848000000E+03
111	708	111	101	0.526900000E+04
112	716	112	101	0.100000000E+[illegible]
114	732	114	101	0.300000000E+[illegible]
115	739	115	100	0.110[illegible]
121	807	126	121	0.435[illegible]
122	820	130	122	0.24[illegible]
123	806	125	123	0.4[illegible]
124	802	124	122	[illegible]
125	805	125	122	[illegible]
126	959	148	12[illegible]	[illegible]
130	819	130	[illegible]	[illegible]
131	822	131	[illegible]	[illegible]
132	832	132	[illegible]	[illegible]
133	840	133	[illegible]	[illegible]
134	848	134	[illegible]	[illegible]
135	856	[illegible]	[illegible]	[illegible]
136	863	[illegible]	[illegible]	[illegible]
137	872	[illegible]	[illegible]	[illegible]
138	879	[illegible]	[illegible]	[illegible]

AD-A189 493 PROCESSING THE ARMY'S WARTIME REPLACEMENTS: THE PREFERRED CONUS REPLACEME (U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF ENGI D L NEPIL 2/2

UNCLASSIFIED DEC 87 AFIT/GOR/ENS/87D-12 F/G 5/9 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

139	881	139	124	0.500000000E+03
140	889	140	124	0.136700000E+04
141	907	141	130	0.155040000E+05
142	916	142	131	0.250000000E+04
143	923	143	130	0.178000000E+04
144	932	144	131	0.330000000E+03
145	940	145	131	0.415000000E+03
146	948	146	131	0.750000000E+03
147	951	147	126	0.350000000E+03
149	972	149	131	0.420000000E+03
150	980	150	131	0.170000000E+04
151	988	151	131	0.675000000E+03
152	995	152	130	0.362900000E+04
153	1004	153	131	0.685000000E+03
154	1011	154	130	0.174000000E+04
155	1014	155	125	0.725000000E+03
156	1028	156	131	0.950000000E+03
157	1035	157	130	0.230000000E+03
158	1044	158	131	0.730000000E+03
159	1052	159	131	0.150000000E+03
160	1060	160	131	0.200000000E+02
161	1067	161	130	0.750000000E+03
162	1076	162	131	0.200000000E+03
163	1084	163	131	0.250000000E+03
8	472	77	71	0.890000000E+02

NONBASIC VARIABLES AT UPPER BOUND

INDEX	NAME	FROM	TO	VALUE

Appendix W: Micro Model SLAM II Code

```
GEN,NEPIL,FT JACKSON,17/06/87,2,,N,,N,Y/S,77;
LIMITS,22,10,10000;
;
;  THIS IS A SIMPLIFIED SIMULATION OF THE FLOW OF SOLDIERS
;  THROUGH THE FORT JACKSON CRC.
;
EQUIVALENCE/ATRIB(2),COMPANY/
           ATRIB(3),PLATOON/
           ATRIB(10),MEALS;
INTLC,XX(1)=0;
NETWORK;
      GATE/LSETUP/CLOSE,2;
      GATE/NOON/CLOSE,13,20;
      GATE/EVE/CLOSE,14,21;
      GATE/NITE/CLOSE,5,15,22;
      RESOURCE/1,UNIT(20),3;
      RESOURCE/2,LCADRE(60),4;
;
;  CREATE THE ARRIVALS OF THE PERSONNEL FROM THE TRAIN BASE
;  ON A DAILY BASIS, THESE SOLDIERS ARRIVE (NORMALLY)
;  BETWEEN 0600 AND 1400 HOURS.  HOWEVER, EACH DAY, THE
;  NUMBER OF ARRIVALS IS DIFFERENT.
;
      CREATE,24,0,1,180,1;
      ASSIGN,XX(1)=XX(1)+1;
TNG   EVENT,6,1;
      UNBATCH,9,1;
      ACT/1,RNORM(10.,4.),,SEND; TNG COUNT
;
;  CREATE THE ARRIVALS OF THE PERSONNEL FROM THE RTD ACCOUNT
;  ON A DAILY BASIS, THESE SOLDIERS ARRIVE (NORMALLY)BETWEEN
;  0700 AND 1700 HOURS.  HOWEVER, EACH DAY, THE NUMBER OF
;  ARRIVALS IS DIFFERENT.
;
      CREATE,24,672,1,152,1;
RTD   EVENT,5,1;
      UNBATCH,8,1;
      ACT/2,RNORM(12.,5.),,SEND; RTD COUNT
;
;  CREATE THE ARRIVALS OF THE PERSONNEL FROM THE TDA ACCOUNT
;  THEIR ARRIVAL SITUATION IS THE SAME AS ABOVE.
;
      CREATE,24,1,1,60,1;
TDA   EVENT,4,1;
      UNBATCH,7,1;
      ACT/3,RNORM(12.,5.),,SEND; TDA COUNT
;
;  CREATE THE ARRIVALS OF THE PERSONNEL FROM THE RT-12 ACCT.
;  THEIR ARRIVAL SITUATION IS THE SAME AS ABOVE.
```

```
;
      CREATE,24,1,1,60,1;
RT12  EVENT,3,1;
      UNBATCH,6,1;
      ACT/4,RNORM(12.,5.),,SEND; RT12 COUNT
;
;  CREATE THE ARRIVALS OF THE PERSONNEL FRCM THE CLV ACCT.
;  THEIR ARRIVAL SITUATION IS THE SAME AS ABOVE.
;
      CREATE,24,1,1,10,1;
CLV   EVENT,2,1;
      UNBATCH,5,1;
      ACT/5,RNORM(12.,5.),,SEND; CLV COUNT
;
;  CREATE THE ARRIVALS OF THE PERSONNEL FROM THE THS ACCT.
;  THEIR ARRIVAL SITUATION IS THE SAME AS ABOVE.
;
      CREATE,24,1,1,10,1;
THS   EVENT,1,1;
      UNBATCH,4,1;
      ACT/6,RNORM(12.,5.),,SEND; THS COUNT
;
;  ASSUME CRC ASSIGNMENTS ARE AS FOLLOWS:
;
SEND  GOON,1;
      ACT,,.357,JACKS;
      ACT,,.214,LEWIS;
      ACT,,,DIX;
LEWIS COLCT,INT(1),LEWIS TIS,,1;
      TERM;
DIX   COLCT,INT(1),DIX TIS,,1;
      TERM;
;
;  SOLDIERS AWAIT PICK UP BY FORT JACKSON CADRE AND BEGIN
;  PROCESSING. ON THEIR FIRST DAY, THE SOLDIERS WILL
;  RECEIVE OVERSEAS ORIENTATION BRIEFINGS FROM THE COMPANY
;  STAFF, WILL MAKE BILLETING ARRANGEMENTS, AND WILL STAND
;  VARIOUS INSPECTIONS AND FORMATIONS.
;
JACKS GOON,1;
;
;  THE FORT JACKSON CRC WILL NOT BE OPERATIONAL UNTIL THE
;  6TH DAY AFTER MOBILIZATION.
;
SETLU AWAIT(2),LSETUP;
      ACT/7; SETUP & OPEN FOR BUSINESS
DAY1  AWAIT(3),UNIT/1;
      ACT/8; UNITS FORM (5 CO MAX 4 PLT PER CO)
MARCH AWAIT(4),LCADRE/1;
      ACT/9,REL(TIMR); CADRE ASSIGNED TO EA PLT
;
;  SLEEP
;
```

```
ZZZ1  AWAIT(5),NITE;
;
;  BREAKFAST/TRANSPORTATION/PERSONNEL CARE/FORMATION
;
      ACT/10; BEGIN DAY2
      FREE,UNIT/1,1;
      ACT/11,2; B1
      ASSIGN,MEALS=MEALS+1;
;
;  SOLDIERS ARE ASSIGNED TO FORT JACKSON REPLACEMENT
;  COMPANIES/PLATOONS.  EACH COMPANY HAS 4 PLATOONS OF 100.
;  FORT JACKSON HAS A MAXIMUM OF 5 COMPANIES.
;
QUE16 QUEUE(6),,,,SORT;
SORT  SELECT,,CYC,,QUE16;
      ACT/12,.1,,UN1;
      ACT/13,.1,,UN2;
      ACT/14,.1,,UN3;
      ACT/15,.1,,UN4;
      ACT/16,.1,,UN17;
      ACT/17,.1,,UN18;
      ACT/18,.1,,UN19;
      ACT/19,.1,,UN20;
      ACT/20,.1,,UN5;
      ACT/21,.1,,UN6;
      ACT/22,.1,,UN7;
      ACT/23,.1,,UN8;
      ACT/24,.1,,UN13;
      ACT/25,.1,,UN14;
      ACT/26,.1,,UN15;
      ACT/27,.1,,UN16;
      ACT/28,.1,,UN9;
      ACT/29,.1,,UN10;
      ACT/30,.1,,UN11;
      ACT/31,.1,,UN12;
UN1   GOON,1;
      ASSIGN,COMPANY=1,PLATOON=1;
      ACT,,,DAY2;
UN2   GOON,1;
      ASSIGN,COMPANY=1,PLATOON=2;
      ACT,,,DAY2;
UN3   GOON,1;
      ASSIGN,COMPANY=1,PLATOON=3;
      ACT,,,DAY2;
UN4   GOON,1;
      ASSIGN,COMPANY=1,PLATOON=4;
      ACT,,,DAY2;
UN5   GOON,1;
      ASSIGN,COMPANY=2,PLATOON=1;
      ACT,,,DAY2;
UN6   GOON,1;
      ASSIGN,COMPANY=2,PLATOON=2;
      ACT,,,DAY2;
```

```
UN7    GOON,1;
       ASSIGN,COMPANY=2,PLATOON=3;
       ACT,,,DAY2;
UN8    GOON,1;
       ASSIGN,COMPANY=2,PLATOON=4;
       ACT,,,DAY2;
UN9    GOON,1;
       ASSIGN,COMPANY=3,PLATOON=1;
       ACT,,,DAY2;
UN10   GOON,1;
       ASSIGN,COMPANY=3,PLATOON=2;
       ACT,,,DAY2;
UN11   GOON,1;
       ASSIGN,COMPANY=3,PLATOON=3;
       ACT,,,DAY2;
UN12   GOON,1;
       ASSIGN,COMPANY=3,PLATOON=4;
       ACT,,,DAY2;
UN13   GOON,1;
       ASSIGN,COMPANY=4,PLATOON=1;
       ACT,,,DAY2;
UN14   GOON,1;
       ASSIGN,COMPANY=4,PLATOON=2;
       ACT,,,DAY2;
UN15   GOON,1;
       ASSIGN,COMPANY=4,PLATOON=3;
       ACT,,,DAY2;
UN16   GOON,1;
       ASSIGN,COMPANY=4,PLATOON=4;
       ACT,,,DAY2;
UN17   GOON,1;
       ASSIGN,COMPANY=5,PLATOON=1;
       ACT,,,DAY2;
UN18   GOON,1;
       ASSIGN,COMPANY=5,PLATOON=2;
       ACT,,,DAY2;
UN19   GOON,1;
       ASSIGN,COMPANY=5,PLATOON=3;
       ACT,,,DAY2;
UN20   GOON,1;
       ASSIGN,COMPANY=5,PLATOON=4;
       ACT;
;
;  ON THE SECOND DAY, THE COMPANIES ARE SPLIT.  HALF
;  PROCESS AT THE MILITARY PERSONNEL OFFICE, AND THE OTHER
;  HALF AT THE HOSPITAL.  AFTER LUNCH, THEY WILL SWITCH
;  LOCATIONS.
;
DAY2   GOON,1;
       ACT/32,,COMPANY.LE.2,MILPO; MILPO
       ACT/33,,COMPANY.GE.4,HOSP; HOSP
       ACT/34,,COMPANY.EQ.3.AND.PLATOON.EQ.2,MILPO; MILPO
       ACT/35,,COMPANY.EQ.3.AND.PLATOON.EQ.3,MILPO; MILPO
```

```
        ACT/36,,,HOSP; HOSP
;
;  AT THE MILPO, THE COMPANY IS SPLIT WITH EACH PLATOON
;  BEGINNING THEIR  PROCESSING AT A DIFFERENT BRANCH.
;  THE PLATOONS THEN ROTATE THROUGH ALL OF THE BRANCHES.
;
MILPO GOON,1;
        ACT/37,,PLATOON.EQ.1,RECDS; RECDS
        ACT/38,,PLATOON.EQ.2,PA; PA
        ACT/39,,PLATOON.EQ.3,PM; PM
        ACT/40,,,SID; SID
;
;  THE RECORDS BRANCH IS RESPONSIBLE FOR UPDATING AND
;  RECONSTRUCTING THE PERSONNEL RECORDS, AND VERIFYING
;  REQUIREMENTS FOR TRAINING, OVERSEAS ORIENTATIONS,
;  REMAINING SERVICE OBLIGATIONS, SOLE SURVIVING SON/DAUGH
;  STATUS, SECURITY CLEARANCES, EMERGENCY NOTIFICATION
;  CARDS, ID TAGS, ID CARDS, ETC.  SIMILARLY, THE PERSONNEL
;  ACTIONS BRANCH IS RESPONSIBLE FOR THE CORRECTION OF ANY
;  PERSONNEL ISSUES.  THE PERSONNEL MANAGEMENT BRANCH IS
;  RESPONSIBLE FOR MANAGEMENT IN TERMS OF MILITARY
;  OCCUPATIONAL SPECIALTIES, RANK, ASSIGNMENTS, AND ORDERS.
;  FINALLY, THE SIDPERS INTERFACE BRANCH MAINTAINS THE ARMY
;  PERSONNEL DATA BASE. AFTER ROTATING THROUGH ALL FOUR
;  BRANCHES, THE PLATOONS WILL BREAK FOR LUNCH.
;
RECDS QUEUE(7);
        ACT/41,USERF(1);  RECDS_PROCESS ü 9 MIN/SOLDIER.
        GOON,1;
        ACT/42,,PLATOON.EQ.2,EAT2; GO TO EAT2
        ACT/43; GO TO PA
PA      QUEUE(8);
        ACT/44,USERF(2);  PA_PROCESS ü 6 MIN/SOLDIER.
        GOON,1;
        ACT/45,,PLATOON.EQ.3,EAT2; GO TO EAT2
        ACT/46; GO TO PM
PM      QUEUE(9);
        ACT/47,USERF(3);  PM_PROCESS ü 7 MIN/SOLDIER.
        GOON,1;
        ACT/48,,PLATOON.EQ.4,EAT2; GO TO EAT2
        ACT/49; GO TO SID
SID     QUEUE(10);
        ACT/50,USERF(4);  SID_PROCESS ü 5 MIN/SOLDIER.
        GOON,1;
        ACT/51,,PLATOON.EQ.1,EAT2; GO TO EAT2
        ACT/52,,,RECDS; GO TO RECDS
;
;  WHILE AT THE HOSPITAL, CHECKS WILL BE MADE TO INSURE
;  THAT ALL INOCULATIONS HAVE BEEN RECEIVED, PROFILE
;  REQUIREMENTS ARE MET, CURRENT DENTAL CHECKS HAVE BEEN
;  MADE, MEDICAL RECORDS ARE IN ORDER, ETC. INITIALLY, TWO
;  PLATOONS WILL REPORT TO THE MEDICAL BRANCH AND THE OTHER
;  TWO WILL PROCESS THROUGH THE DENTAL BRANCH.  THE
```

```
;  PLATOONS WILL ROTATE AS APPROPRIATE THEN BREAK FOR LUNCH.
;
HOSP  GOON,1;
      ACT/53,,PLATOON.LE.2,MED; MED
      ACT/54,,,DENT; DENT
;
MED   QUEUE(11);
      ACT/55,USERF(5); MED_PROCESS ü 10 MIN/SOLDIER.
      GOON,1;
      ACT/56,,PLATOON.GT.2,EAT2; GO TO EAT2
      ACT/57; GO TO DENT
DENT  QUEUE(12);
      ACT/58,USERF(6); DENT_PROCESS ü 6 MIN/SOLDIER.
      GOON,1;
      ACT/59,,PLATOON.LT.3,EAT2; GO TO EAT2
      ACT/60,,,MED; GO TO MED
;
EAT2  GOON,1;
      ACT/61,,MEALS.EQ.2,DINNER; GO TO DINNER
      ACT/62; GO TO LUNCH
      ASSIGN,MEALS=MEALS+1;
LUNCH AWAIT(13),NOON,,1;
      ACT/63,1,COMPANY.GE.4,MILPO; MILPO
      ACT/64,1,COMPANY.LE.2,HOSP; HOSP
      ACT/65,1,COMPANY.EQ.3.AND.PLATOON.EQ.1,MILPO; MILPO
      ACT/66,1,COMPANY.EQ.3.AND.PLATOON.EQ.4,MILPO; MILPO
      ACT/67,1,,HOSP; HOSP
;
DINNERAWAIT(14),EVE;
      ACT/68,1; D2
      ASSIGN,MEALS=MEALS+1;
;
;  OVERSEAS ORIENTATIONS
;
      GOON,1;
      ACT/69,2; OO2
;
;  COMMANDERS' TIME
;
      GOON,1;
      ACT/70,3; CT2
;
;  SLEEP
;
ZZZ2  AWAIT(15),NITE;
;
;  BREAKFAST/TRANSPORTATION/PERSONNEL CARE/FORMATION
;
      ACT/71,2; B3
      ASSIGN,MEALS=MEALS+1;
;
;  ON THE THIRD DAY, HALF OF THE COMPANIES REPORT TO THE
;  CENTRAL ISSUE FACILITY TO DRAW NECESSARY INDIVIDUAL
```

```
;  EQUIPMENT, ORGANIZATIONAL CLOTHING, CHEMICAL
;  PROTECTIVE CLOTHING AND MASK.  THE OTHER HALF REPORT TO
;  THE ARMS ROOM TO DRAW M-16S.
;
DAY3  GOON,1;
      ACT/72,,COMPANY.LE.2,CIF; CIF
      ACT/73,,COMPANY.GE.4,ARMS; ARMS
      ACT/74,,COMPANY.EQ.3.AND.PLATOON.LE.2,CIF; CIF
      ACT/75,,,ARMS; ARMS
;
CIF   QUEUE(16);
      ACT/76,USERF(7); CIF_PROCESS ū 3 MIN/SOLDIER.
;
;  TRAVEL TO AND PREPARATION FOR THE GAS CHAMBERS.
;
      GOON,1;
      ACT/77,1; PREP GAS
;
;  GAS CHAMBER EXERCISE.
;
GAS   QUEUE(17);
      ACT/78,USERF(8); GAS_PROCESS ū 5 MIN/SOLDIER.
;
;  RECOVERY/TRANSPORTATION/MAINTENANCE
;
      GOON,1;
      ACT/79,1,,EAT3; RECOVER GAS
;
ARMS  QUEUE(18);
      ACT/80,USERF(9); ARMS_PROCESS ū 1 MIN/SOLDIER.
;
;  TRAVEL TO AND PREPARATION FOR THE LIVE FIRE EXERCISE.
;
      GOON,1;
      ACT/81,1; PREP RANGE
;
;  ZEROING OF INDIVIDUAL WEAPONS
;
RANGE QUEUE(19);
      ACT/82,USERF(10); RANGE_PROCESS ū 12 MIN/SOLDIER.
;
;  CLEANING/MAINTENANCE/TRANSPORTATION
;
      GOON,1;
      ACT/83,2; CLEAN
;
;  LUNCH AND ROTATION
;
EAT3  GOON,1;
      ACT/84,,MEALS.EQ.5,DINER; GO TO DINER
      ACT/85; GO TO LNCH
      ASSIGN,MEALS=MEALS+1;
LNCH  AWAIT(20),NOON,,1;
```

```
        ACT/86,1,COMPANY.GE.4,CIF; CIF
        ACT/87,1,COMPANY.LE.2,ARMS; ARMS
        ACT/88,1,COMPANY.EQ.3.AND.PLATOON.GE.3,CIF; CIF
        ACT/89,1,,ARMS; ARMS
;
DINER   AWAIT(21),EVE;
        ACT/90,1; D3
        ASSIGN,MEALS=MEALS+1;
;
;   BRIEFINGS BY THE MOVEMENT CONTROL BRANCH (S2/S3)
;
        GOON,1;
        ACT/91,3; MCB
;
;   SLEEP
;
ZZZ3    AWAIT(22),NITE;
;
;   BREAKFAST/TRANSPORTATION/PERSONNEL CARE/FORMATION
;
        ACT/92,2; B4
        ASSIGN,MEALS=MEALS+1;
;
;   ON THE FOURTH DAY, SOLDIERS RECEIVE ANY FINAL
;   BRIEFINGS/ASSISTANCE, AND ARE TRANSPORTED TO THE APOE
;   (IN THIS CASE - CHARLESTON)
;
DAY4    GOON;
        ACT/93,3; APOE
        GOON,1;
        ACT,,XX(1).LE.10,CL1;
        ACT,,XX(1).LE.20,CL2;
        ACT,,XX(1).LE.30,CL3;
        ACT,,XX(1).LE.40,CL4;
        ACT,,XX(1).LE.50,CL5;
        ACT,,XX(1).LE.60,CL6;
        ACT,,XX(1).LE.70,CL7;
        ACT,,XX(1).LE.80,CL8;
        ACT,,XX(1).LE.90,CL9;
        ACT,,XX(1).LE.100,CL10;
        ACT,,XX(1).LE.110,CL11;
        ACT,,XX(1).LE.120,CL12;
        ACT,,XX(1).LE.130,CL13;
        ACT,,XX(1).LE.140,CL14;
        ACT,,XX(1).LE.150,CL15;
        ACT,,XX(1).LE.160,CL16;
        ACT,,XX(1).LE.170,CL17;
        ACT,,XX(1).LE.180,CL18;
CL1     COLCT,INT(1),JACKSON TIS1;
        FREE,LCADRE/1,1;
        TERM;
CL2     COLCT,INT(1),JACKSON TIS2;
        FREE,LCADRE/1,1;
```

```
        TERM;
CL3     COLCT,INT(1),JACKSON TIS3;
        FREE,LCADRE/1,1;
        TERM;
CL4     COLCT,INT(1),JACKSON TIS4;
        FREE,LCADRE/1,1;
        TERM;
CL5     COLCT,INT(1),JACKSON TIS5;
        FREE,LCADRE/1,1;
        TERM;
CL6     COLCT,INT(1),JACKSON TIS6;
        FREE,LCADRE/1,1;
        TERM;
CL7     COLCT,INT(1),JACKSON TIS7;
        FREE,LCADRE/1,1;
        TERM;
CL8     COLCT,INT(1),JACKSON TIS8;
        FREE,LCADRE/1,1;
        TERM;
CL9     COLCT,INT(1),JACKSON TIS9;
        FREE,LCADRE/1,1;
        TERM;
CL10    COLCT,INT(1),JACKSON TIS10;
        FREE,LCADRE/1,1;
        TERM;
CL11    COLCT,INT(1),JACKSON TIS11;
        FREE,LCADRE/1,1;
        TERM;
CL12    COLCT,INT(1),JACKSON TIS12;
        FREE,LCADRE/1,1;
        TERM;
CL13    COLCT,INT(1),JACKSON TIS13;
        FREE,LCADRE/1,1;
        TERM;
CL14    COLCT,INT(1),JACKSON TIS14;
        FREE,LCADRE/1,1;
        TERM;
CL15    COLCT,INT(1),JACKSON TIS15;
        FREE,LCADRE/1,1;
        TERM;
CL16    COLCT,INT(1),JACKSON TIS16;
        FREE,LCADRE/1,1;
        TERM;
CL17    COLCT,INT(1),JACKSON TIS17;
        FREE,LCADRE/1,1;
        TERM;
CL18    COLCT,INT(1),JACKSON TIS18;
        FREE,LCADRE/1,1;
        TERM;
;
; OPEN THE FORT JACKSON CRC ON THE 6TH DAY AFTER
; MOBILIZATION.
;
```

```
      CREATE,,126;
      OPEN,LSETUP;
      TERM;
;
;  OPEN AND CLOSE THE DINING FACILITY FOR THE NOON AND
;  EVENING MEALS.
;
      CREATE,24,10.0;
      OPEN,NOON;
      ACT,5;
      CLOSE,NOON;
      TERM;
;
      CREATE,24,16.0;
      OPEN,EVE;
      ACT,5;
      CLOSE,EVE;
      TERM;
;
;  WAKE UP AT 0500 HOURS EVERY MORNING
;
      CREATE,24,5;
      OPEN,NITE;
      ACT,1;
      CLOSE,NITE;
      TERM;
;
;  TIMER TO TERMINATE THE FIRST DAY ACTIVITIES AT 2300 HRS.
;
TIMR  CREATE,24,23;
      TERM;
      END;
INIT,0,4320;
;MONTR,TRACE,125,210,1,2,3,10,XX(1),NNRSC(1),NNRSC(2);
;MONTR,TRACE,370,400,1,2,3,4,5,XX(1),NNQ(15),NNRSC(1);
FIN;
```

```
      PROGRAM MAIN
      DIMENSION NSET(200000)
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     1,MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),
     1,SSL(100),TNEXT,TNOW,XX(100)
      COMMON QSET(200000)
      EQUIVALENCE(NSET(1),QSET(1))
      NNSET=200000
      NCRDR=5
      NPRNT=6
      NTAPE=7
      NPLOT=2
      CALL SLAM
```

```
      STOP
      END
C
C
C
      SUBROUTINE EVENT(I)
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     1,MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),
     1,SSL(100),TNEXT,TNOW,XX(100)
C
      GO TO (1,2,3,4,5,6)I
C
C*****ONE ENTITY EQUALS 10 SOLDIERS.
C
C*****ATRIB(4) IS THE TRANSIENT, HOLDEE, STUDENT ACCOUNT.
C
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 1
    1 IF (XX(1).EQ.1.) THEN
        ATRIB(4)=10
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 2
      ELSE IF (XX(1).EQ.2.) THEN
        ATRIB(4)=40
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 3
      ELSE IF (XX(1).EQ.3.) THEN
        ATRIB(4)=80
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 4
      ELSE IF (XX(1).EQ.4.) THEN
        ATRIB(4)=120
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 5
      ELSE IF (XX(1).EQ.5.) THEN
        ATRIB(4)=170
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 6
      ELSE IF (XX(1).EQ.6.) THEN
        ATRIB(4)=220
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 7
      ELSE IF (XX(1).EQ.7.) THEN
        ATRIB(4)=240
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 8
      ELSE IF (XX(1).EQ.8.) THEN
        ATRIB(4)=190
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 9
      ELSE IF (XX(1).EQ.9.) THEN
        ATRIB(4)=110
C*****NUMBER OF THS PERSONNEL WHO ARRIVE ON DAY 10
      ELSE
        ATRIB(4)=62
      END IF
      RETURN
C
C*****ATRIB(5) IS THE ACCOUNT CONSISTING OF SOLDIERS WHO ARE
C*****ON CONUS LEAVE AND ARE ASSIGNED TO A DEPLOYED UNIT
C*****OVERSEAS.
C
```

```
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 1
    2 IF (XX(1).EQ.1.) THEN
        ATRIB(5)=10
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 2
      ELSE IF (XX(1).EQ.2.) THEN
        ATRIB(5)=20
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 3
      ELSE IF (XX(1).EQ.3.) THEN
        ATRIB(5)=80
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 4
      ELSE IF (XX(1).EQ.4.) THEN
        ATRIB(5)=160
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 5
      ELSE IF (XX(1).EQ.5.) THEN
        ATRIB(5)=240
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 6
      ELSE IF (XX(1).EQ.6.) THEN
        ATRIB(5)=170
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 7
      ELSE IF (XX(1).EQ.7.) THEN
        ATRIB(5)=90
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 8
      ELSE IF (XX(1).EQ.8.) THEN
        ATRIB(5)=30
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 9
      ELSE IF (XX(1).EQ.9.) THEN
        ATRIB(5)=10
C*****NUMBER OF CLV PERSONNEL WHO ARRIVE ON DAY 10
      ELSE
        ATRIB(5)=10
      END IF
      RETURN
C
C*****ATRIB(6) IS THE ACCOUNT FOR THOSE SOLDIERS WHO ARE IN
C*****THE INDIVIDUAL READINESS RESERVE AND WHO HAVE SERVED
C*****ON ACTIVE DUTY WITHIN THE LAST 12 MONTHS.
C
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 1
    3 IF (XX(1).EQ.1.) THEN
        ATRIB(6)=10
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 2
      ELSE IF (XX(1).EQ.2.) THEN
        ATRIB(6)=20
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 3
      ELSE IF (XX(1).EQ.3.) THEN
        ATRIB(6)=70
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 4
      ELSE IF (XX(1).EQ.4.) THEN
        ATRIB(6)=100
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 5
      ELSE IF (XX(1).EQ.5.) THEN
        ATRIB(6)=180
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 6
```

```
      ELSE IF (XX(1).EQ.6.) THEN
        ATRIB(6)=340
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 7
      ELSE IF (XX(1).EQ.7.) THEN
        ATRIB(6)=380
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 8
      ELSE IF (XX(1).EQ.8.) THEN
        ATRIB(6)=340
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 9
      ELSE IF (XX(1).EQ.9.) THEN
        ATRIB(6)=270
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAY 10
      ELSE IF (XX(1).EQ.10.) THEN
        ATRIB(6)=165
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAYS 11-20
      ELSE IF (XX(1).GE.11.0.AND.XX(1).LE.20.) THEN
        ATRIB(6)=135
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAYS 21-30
      ELSE IF (XX(1).GE.21.0.AND.XX(1).LE.30.) THEN
        ATRIB(6)=120
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAYS 31-40
      ELSE IF (XX(1).GE.31.0.AND.XX(1).LE.40.) THEN
        ATRIB(6)=30
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAYS 41-50
      ELSE IF (XX(1).GE.41.0.AND.XX(1).LE.50.) THEN
        ATRIB(6)=30
C*****NUMBER OF RT12 PERSONNEL WHO ARRIVE ON DAYS 51-60
      ELSE
        ATRIB(6)=23
      END IF
      RETURN
C
C*****ATRIB(7) IS THE ACCOUNT FOR THOSE SOLDIERS WHO ARE
C*****CURRENTLY IN A TABLE OF DISTRIBUTION AND ALLOWANCES
C**** POSITION AND HAVE BEEN RELEASED FOR OVERSEAS DUTY
C*****BY AN RT-12.
C
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 1
    4 IF (XX(1).EQ.1.) THEN
        ATRIB(7)=20
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 2
      ELSE IF (XX(1).EQ.2.) THEN
        ATRIB(7)=70
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 3
      ELSE IF (XX(1).EQ.3.) THEN
        ATRIB(7)=150
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 4
      ELSE IF (XX(1).EQ.4.) THEN
        ATRIB(7)=250
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 5
      ELSE IF (XX(1).EQ.5.) THEN
        ATRIB(7)=400
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 6
```

```
      ELSE IF (XX(1).EQ.6.) THEN
        ATRIB(7)=700
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 7
      ELSE IF (XX(1).EQ.7.) THEN
        ATRIB(7)=750
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 8
      ELSE IF (XX(1).EQ.8.) THEN
        ATRIB(7)=600
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 9
      ELSE IF (XX(1).EQ.9.) THEN
        ATRIB(7)=350
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAY 10
      ELSE IF (XX(1).EQ.10.) THEN
        ATRIB(7)=149
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAYS 11-20
      ELSE IF (XX(1).GE.11.0.AND.XX(1).LE.20.) THEN
        ATRIB(7)=118
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAYS 21-30
      ELSE IF (XX(1).GE.21.0.AND.XX(1).LE.30.) THEN
        ATRIB(7)=105
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAYS 31-40
      ELSE IF (XX(1).GE.31.0.AND.XX(1).LE.40.) THEN
        ATRIB(7)=26
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAYS 41-50
      ELSE IF (XX(1).GE.41.0.AND.XX(1).LE.50.) THEN
        ATRIB(7)=26
C*****NUMBER OF TDA PERSONNEL WHO ARRIVE ON DAYS 51-60
      ELSE
        ATRIB(7)=20
      END IF
      RETURN
C
C*****ATRIB(8) IS THE ACCOUNT FOR THOSE SOLDIERS WHO HAVE
C*****BEEN RECOVERING FROM AN INJURY OF ILLNESS AND ARE
C*****NOW READY TO RETURN TO OVERSEAS DUTY.
C
C*****THERE ARE ZERO RTD SOLDIERS UNTIL DAY 29.
C
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAY 29
    5 IF (XX(1).EQ.29.) THEN
        ATRIB(8)=22
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAY 30
      ELSE IF (XX(1).EQ.30.) THEN
        ATRIB(8)=21
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 31-40
      ELSE IF (XX(1).GE.31.0.AND.XX(1).LE.40.) THEN
        ATRIB(8)=20
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 41-50
      ELSE IF (XX(1).GE.41.0.AND.XX(1).LE.50.) THEN
        ATRIB(8)=25
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 51-60
      ELSE IF (XX(1).GE.51.0.AND.XX(1).LE.60.) THEN
        ATRIB(8)=25
```

```
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 61-70
      ELSE IF (XX(1).GE.61.0.AND.XX(1).LE.70.) THEN
        ATRIB(8)=61
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 71-80
      ELSE IF (XX(1).GE.71.0.AND.XX(1).LE.80.) THEN
        ATRIB(8)=71
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 81-90
      ELSE IF (XX(1).GE.81.0.AND.XX(1).LE.90.) THEN
        ATRIB(8)=76
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 91-120
      ELSE IF (XX(1).GE.91.0.AND.XX(1).LE.120.) THEN
        ATRIB(8)=104
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 121-150
      ELSE IF (XX(1).GE.121.0.AND.XX(1).LE.150.) THEN
        ATRIB(8)=94
C*****NUMBER OF RTD PERSONNEL WHO ARRIVE ON DAYS 151-180
      ELSE
        ATRIB(8)=114
      END IF
      RETURN
C
C*****ATRIB(9) IS THE ACCOUNT FOR THOSE SOLDIERS WHO HAVE
C*****JUST GRADUATED FROM THE TRAINING BASE AND ARE READY
C*****FOR OVERSEAS DUTY.
C
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 1-10
    6 IF (XX(1).GE.1.0.AND.XX(1).LE.10.) THEN
        ATRIB(9)=94
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 11-20
      ELSE IF (XX(1).GE.11.0.AND.XX(1).LE.20.) THEN
        ATRIB(9)=94
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 21-30
      ELSE IF (XX(1).GE.21.0.AND.XX(1).LE.30.) THEN
        ATRIB(9)=92
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 31-40
      ELSE IF (XX(1).GE.31.0.AND.XX(1).LE.40.) THEN
        ATRIB(9)=91
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 41-50
      ELSE IF (XX(1).GE.41.0.AND.XX(1).LE.50.) THEN
        ATRIB(9)=76
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 51-60
      ELSE IF (XX(1).GE.51.0.AND.XX(1).LE.60.) THEN
        ATRIB(9)=95
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 61-70
      ELSE IF (XX(1).GE.61.0.AND.XX(1).LE.70.) THEN
        ATRIB(9)=90
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 71-80
      ELSE IF (XX(1).GE.71.0.AND.XX(1).LE.80.) THEN
        ATRIB(9)=134
C*****NUMBER OF TNG PERSONNEL WHO ARRIVE ON DAYS 81-180
      ELSE
        ATRIB(9)=321
      END IF
```

```
      RETURN
      END
C
C
      SUBROUTINE INTLC
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     1,MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),
     1,SSL(100),TNEXT,TNOW,XX(100)
C     LEAVE BLANK IF NOTHING TO INITIALIZE
      RETURN
      END
C
C
C
      SUBROUTINE OTPUT
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     1,MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),
     1,SSL(100),TNEXT,TNOW,XX(100)
C      LEAVE BLANK IF NO SPECIAL OUTPUT
       RETURN
       END
C
C
C
      SUBROUTINE OTPUT
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,
     1,MFA,MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,
     1,SS(100),SSL(100),TNEXT,TNOW,XX(100)
C      LEAVE BLANK IF NO SPECIAL OUTPUT
       RETURN
       END
C
C
C
      FUNCTION USERF(I)
      COMMON/SCOM1/ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     1,MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),
     1,SSL(100),TNEXT,TNOW,XX(100)
      GO TO (1,2,3,4,5,6,7,8,9,10)I
C
C*****RECORDS BRANCH
C
C*****"STIME" IS THE AVERAGE EXPECTED SERVICE TIME PER
C*****SOLDIER (IN MINUTES PER SOLDIER.
    1 STIME=9.0
C*****IN THE FIRST 40 DAYS, THERE WILL BE THE REQUIREMENT
C**** TO PROCESS TEN PLATOONS IN FIVE HOURS.  THUS, THE
C*****NUMBER OF REQUIRED SERVERS IS AS FOLLOWS: 10
C*****PLATOONS IN 5 HOURS TIMES 100 SOLDIERS PER PLATOON
C*****TIMES 60 MINUTES PER HOUR TIMES STIME
      IF (XX(1).LE.960.) THEN
        NSERVER = 10. * (1./5.) * 100. * (1./60.) * STIME
      ELSE
```

```
          NSERVER = 6. * (1./5.) * 100. * (1./60.) * STIME
        END IF
C*****BASED ON NSERVER AND STIME, EACH PLATOON REQUIRES
C*****THE FOLLOWING AMOUNT OF TIME (IN HOURS) TO BE
C*****PROCESSED
        Z = (1./NSERVER) * STIME * (1./60.) * 100.
        USERF = RNORM(Z,.015,8)
        RETURN
C
C*****PA BRANCH
C
      2 STIME = 6.0
        IF (XX(1).LE.960.) THEN
          NSERVER = 10. * (1./5.) * 100. * (1./60.) * STIME
        ELSE
          NSERVER = 6. * (1./5.) * 100. * (1./60.) * STIME
        END IF
        Z = (1./NSERVER) * STIME * (1./60.) * 100.
        USERF = RNORM(Z,.015,4)
        RETURN
C
C*****PM BRANCH
C
      3 STIME = 7.0
        IF (XX(1).LE.960.) THEN
          NSERVER = 10. * (1./5.) * 100. * (1./60.) * STIME
        ELSE
          NSERVER = 6. * (1./5.) * 100. * (1./60.) * STIME
        END IF
        Z = (1./NSERVER) * STIME * (1./60.) * 100.
        USERF = RNORM(Z,.015,2)
        RETURN
C
C*****SID BRANCH
C
      4 STIME = 5.0
        IF (XX(1).LE.960.) THEN
          NSERVER = 10. * (1./5.) * 100. * (1./60.) * STIME
        ELSE
          NSERVER = 6. * (1./5.) * 100. * (1./60.) * STIME
        END IF
        Z = (1./NSERVER) * STIME * (1./60.) * 100.
        USERF = RNORM(Z,.015,7)
        RETURN
C
C*****MEDICAL BRANCH
C
      5 STIME = 10.0
        IF (XX(1).LE.960.) THEN
          NSERVER = 10. * (1./5.) * 100. * (1./60.) * STIME
        ELSE
          NSERVER = 6. * (1./5.) * 100. * (1./60.) * STIME
        END IF
```

```
      Z = (1./NSERVER) * STIME * (1./60.) * 100.
      USERF = RNORM(Z,.015,4)
      RETURN
C
C*****DENTAL BRANCH
C
    6 STIME = 6.0
      IF (XX(1).LE.960.) THEN
        NSERVER = 10. * (1./5.) * 100. * (1./60.) * STIME
      ELSE
        NSERVER = 6. * (1./5.) * 100. * (1./60.) * STIME
      END IF
      Z = (1./NSERVER) * STIME * (1./60.) * 100.
      USERF = RNORM(Z,.015,8)
      RETURN
C
C*****CIF (AVAILABLE TIME IS 2 HRS INSTEAD OF 5 HRS)
C
    7 STIME = 3.0
      IF (XX(1).LE.960.) THEN
        NSERVER = 10. * (1./2.) * 100. * (1./60.) * STIME
      ELSE
        NSERVER = 6. * (1./2.) * 100. * (1./60.) * STIME
      END IF
      Z = (1./NSERVER) * STIME * (1./60.) * 100.
      USERF = RNORM(Z,.015,3)
      RETURN
C
C*****GAS CHAMBER (AVAILABLE TIME IS 2 HRS INSTEAD OF 5 HRS)
C
    8 STIME = 5.0
      IF (XX(1).LE.960.) THEN
        NSERVER = 10. * (1./2.) * 100. * (1./60.) * STIME
      ELSE
        NSERVER = 6. * (1./2.) * 100. * (1./60.) * STIME
      END IF
      Z = (1./NSERVER) * STIME * (1./60.) * 100.
      USERF = RNORM(Z,.015,1)
      RETURN
C
C*****ARMS ROOM (AVAILABLE TIME IS 1 HR INSTEAD OF 5 HRS)
C
    9 STIME = 1.0
      IF (XX(1).LE.960.) THEN
        NSERVER = 10. * (1./1.) * 100. * (1./60.) * STIME
      ELSE
        NSERVER = 6. * (1./1.) * 100. * (1./60.) * STIME
      END IF
      Z = (1./NSERVER) * STIME * (1./60.) * 100.
      USERF = RNORM(Z,.015,9)
      RETURN
C
C*****RIFLE RANGE (AVAILABLE TIME IS 3 HRS INSTEAD OF 5 HRS)
```

```
C
   10 STIME = 12.0
      IF (XX(1).LE.960.) THEN
        NSERVER = 10. * (1./3.) * 100. * (1./60.) * STIME
      ELSE
        NSERVER = 6. * (1./3.) * 100. * (1./60.) * STIME
      END IF
      Z = (1./NSERVER) * STIME * (1./60.) * 100.
      USERF = RNORM(Z,.015,5)
      RETURN
      END
```

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VITA

Captain Darell L. Nepil was born on 18 January 1955 in Havre, Montana. He graduated from high school in Big Sandy, Montana in 1973 and attended the United States Military Academy at West Point, New York. He earned a Bachelor of Science in Engineering degree and was commissioned an officer in the Field Artillery in June 1977. His military education includes the United States Army Airborne and Ranger Schools, the Field Artillery Officer Basic and Missile Courses, and the Adjutant General Officer Advance Course.

Captain Nepil has experience a broad spectrum of Field Artillery and Adjutant General assignments. He has served as a Special Weapons Team Officer with the Eighth Army in Chunchon, Korea. He has served as an Adjutant and an Executive Officer with the Eighth Infantry Division in Baumholder, Germany. Finally, he has served as an instructor in the Adjutant General School and has served on the staff of the Commanding General at the Soldier Support Center, Fort Benjamin Harrison, Indiana.

He entered the Graduate of Operations Research Program at the School of Engineering, Air Force Institute of Technology in June 1986. He is married to the former Mary K. Barger.

Permanent address: 3844 NW Clover Place
Corvallis, Oregon 97330

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